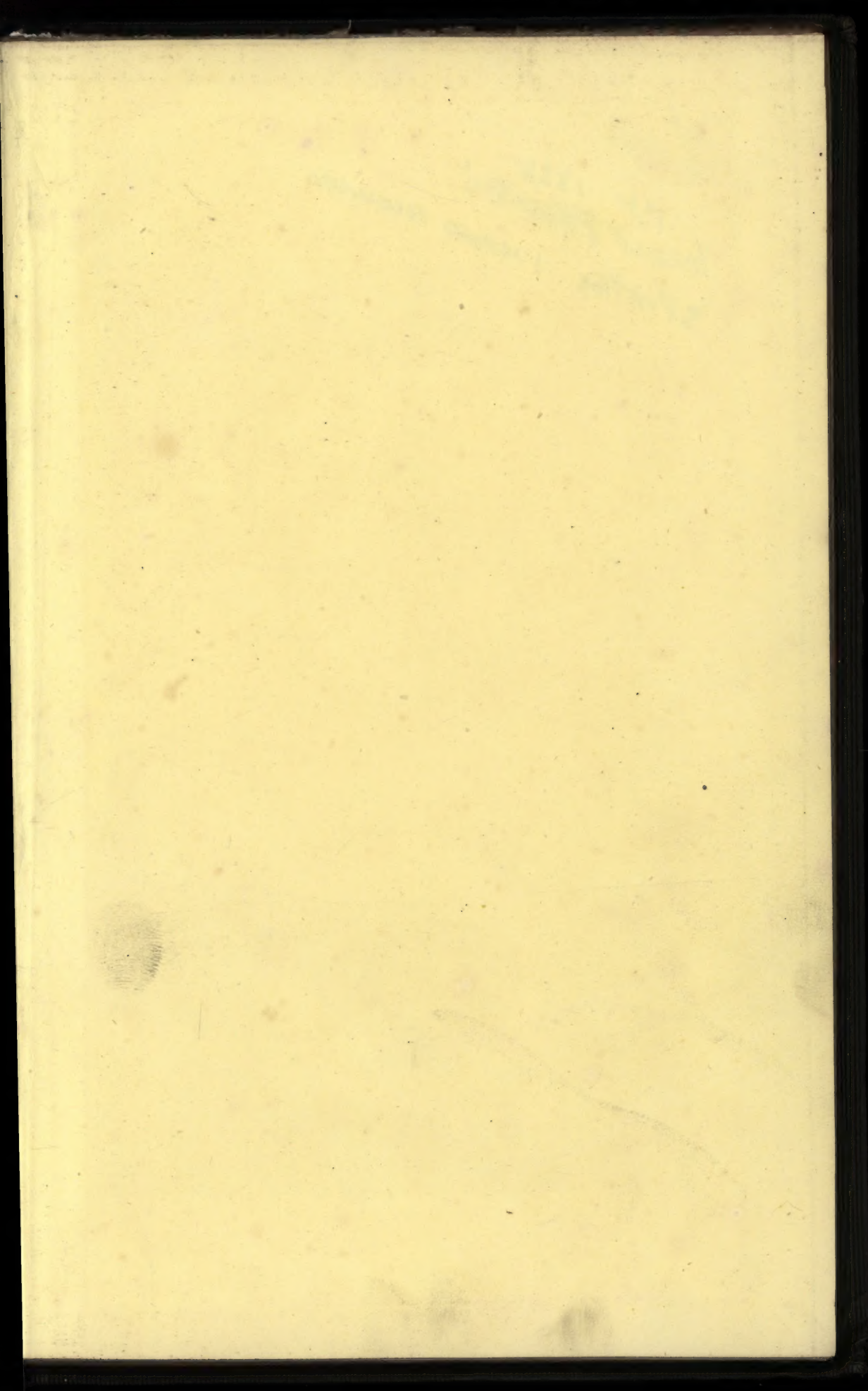
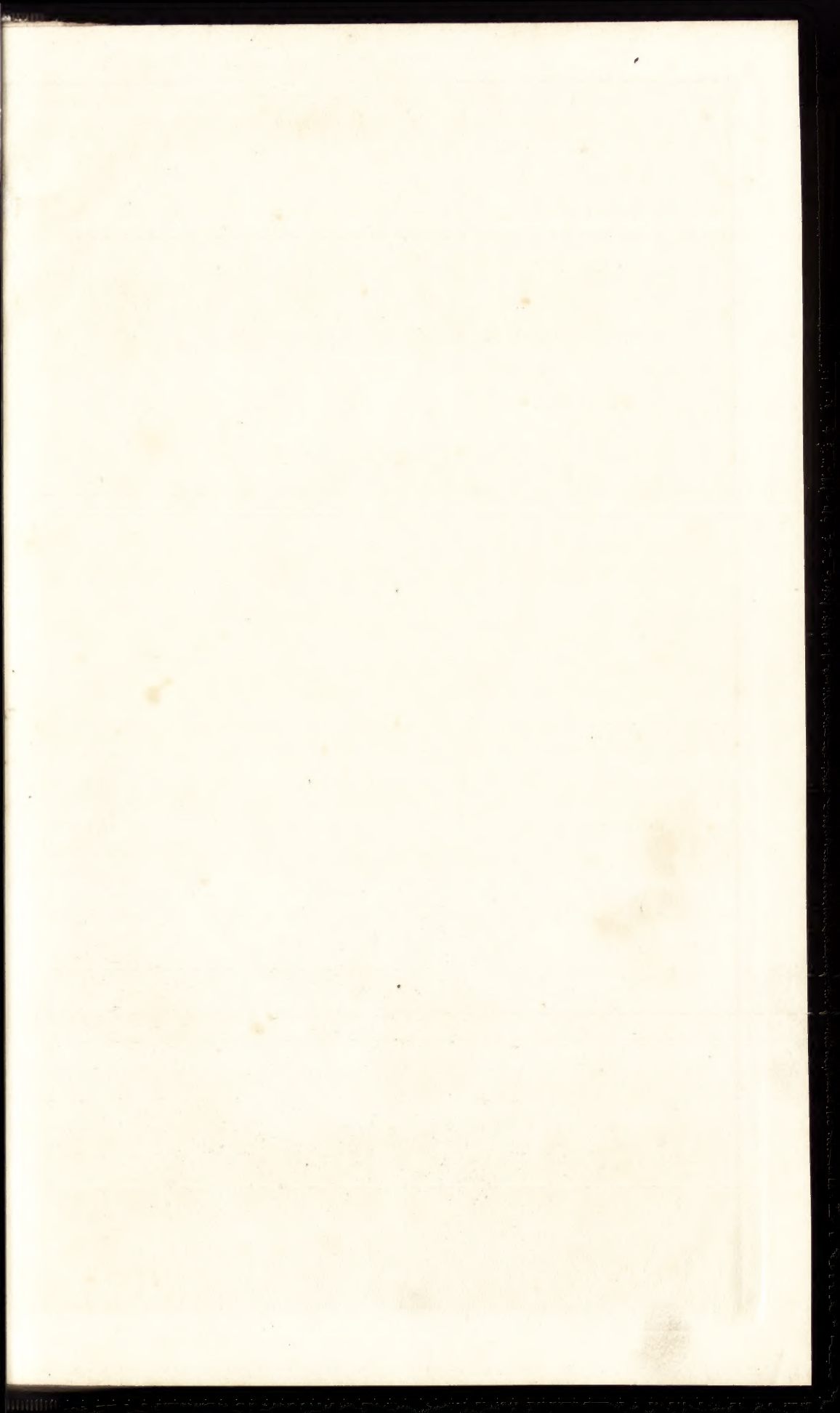


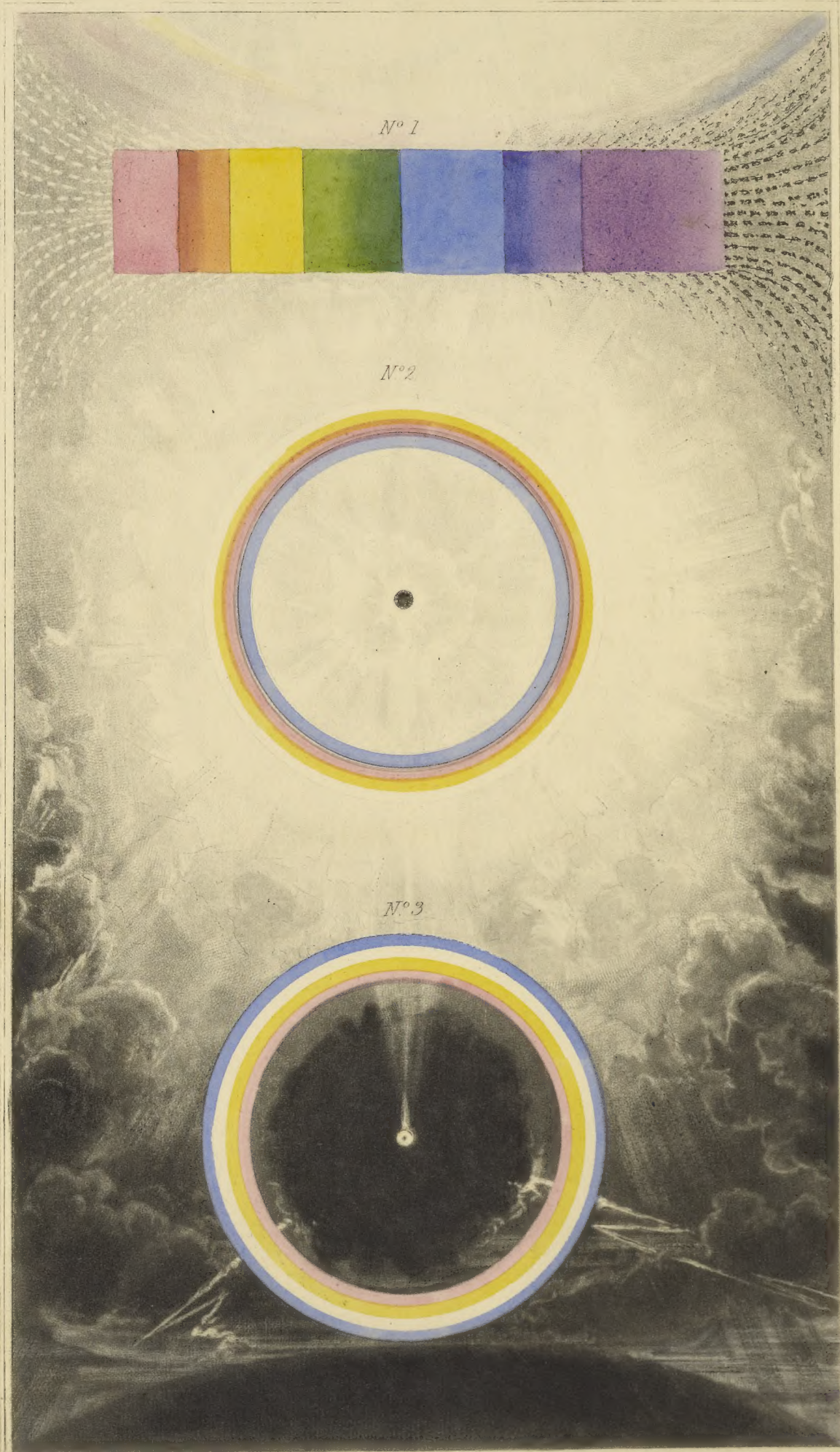
Plater drawn by GEO Field

See G. Field & his sister



1st. 1838
Colour Frontis
3 Plates 1 Hand Coloured





Drawn by Geo. Field.

Engraved by David Lucas.

ON THE
ELEMENTS OF LIGHT,
AND THEIR IDENTITY WITH THOSE
OF
MATTER,
RADIANT AND FIXED,

BY
JOHN HOWARD KYAN.

וַיֹּאמֶר אֱלֹהִים יְהִי אוֹר וַיְהִי אֹר:

Kai eipen o Theos, Genethetai Phos, kai egeneto Phos.

Genesis, Chap. I. ver. 3.

LONDON:
LONGMAN, ORME, BROWN, GREEN, AND LONGMAN,
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—
1838.

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ADDRESS.

To the Scientific World generally, I beg leave to observe, in defence of the STARTLING ASSERTIONS I am (with such apparent presumption) about to present for their most rigid investigation, that I have been solely influenced by the unconquerable love of TRUTH with which I am impressed, and by which I am urged again to proclaim opinions I have entertained, with but little modification, for a period of NINETEEN YEARS ; during which, every one, without exception, of the *important discoveries* that have been made, that bear upon the subject of Light, Heat, Electricity, the Voltaic influences, and Magnetic forces, (and more particularly the IDENTITY of the three latter,) have all conspired to substantiate my hypothetical views, and to support and confirm the opinions I entertain of their rectitude. I feel it my duty thus to submit the following "Theory of Light" to the proper ordeal ; and, in addition to the testimonies, analagous, collateral, and direct, which are at present adduced, there is one unerring, and above all Evidence of Human Philosophy, on which I confidently rely—

"And God said, Let there be LIGHT : and there was LIGHT."

Genesis, chap. i. v. 3.

As an Admirer of Science, I offer my humble acknowledgments and thanks to "The Ladies of the British Isles," who visit our Philosophical Associations and Institutions, and, by their cheering presence, do so much for the encouragement and cultivation of the Sciences, and the beneficial BIAS of the public taste for intellectual enjoyments, (which the elucidations of TRUTH are so well calculated to inspire,) and for still more, their inestimable example to the rising generation, over whose destinies those fair arbiters are so happily appointed to preside.

THE AUTHOR.

*Cheltenham,
6th January, 1838.*

P R E F A C E.

THE subject which I have undertaken to bring before the consideration of the scientific reader is one of acknowledged importance, and requires, to do it justice, the exertion of talent, time, and application, beyond my humble pretension. I therefore wish it had fallen to more efficient hands to bring it forward, with the requisite advantages due to the merits of such a discussion.

There is a cautious negative system of tactics in strong alliance with our present School of Philosophy, valuable as to the preservation of our views within the bounds of well-defined and "pace-worn" paths, macadamised, with a host of stubborn incontrovertible facts, which guide the erratic investigator, and prevent his soaring above their horizon, and perchance losing his way in the inviting mazes of speculative inquiry—and this is *so far beneficial*; but its disadvantages are equally obvious from its powers of restriction and contraction, which keep enchained the inspiring spirit of investigation, from which, in the bare collision of adverse opinion, some new facts of benefit to science may be derived.

If, on the other hand, we rest satisfied with the limits of our meandering ways on the verge of an immense circle, to the centre of which we are only to approach by parallels as formal

and regular as those adopted in military investments, it is not likely that we can (with all our efforts of industry) reach the desired MAGAZINE OF PHYSICAL KNOWLEDGE, under a lapse of time that would dishearten the most undaunted and persevering amongst us to contemplate.

Since MECHANICAL Science has flourished by attaining the increased velocity of LOCOMOTION, I am desirous to learn, may we not search for, and find, the GENIUS of a BRUNEL in our PHYSICAL SECTION, to give us an IMPETUS?—*some practical Analytical Operator of eminence*, who, not content with MINUTIÆ, will afford us experimentally, and with mathematical accordance to TRUTH, the grand, the *sublime simplicity* of a System of Physics, which will expose, overturn, and discard, the irrational *complexity*, that is but too apparent in our present code of elementary, or undecomposed constituents.

It is to seek the aid of such a GENIUS, (and many there are to be found amongst ourselves, and *our pre-eminent and distinguished brothers in philosophy on the continent*,) that I have thus stepped out of my sphere, to intrude my views and opinions on the notice of the Public.

THE AUTHOR.

It may be necessary to give some explanation of the Frontispiece, lest the reader impute to it a mystic, symbolical character, other than it is intended to convey.

No. 1 represents the Spectrum produced by the Newtonian Prism with the prismatic Colours, and the emblematical representation of the Magnetic forces.

No. 2 exhibits the appearance of the Aureola, obtained by the action of the Lenticular Prism of Field, on a black spot, on the white ground.

No. 3 is the Aureola from a white spot, on a dark or black ground, by the same instrument ;—for the explanation of the back-ground of the lower Diagram, the reader is referred to the first ten verses of the 1st Chapter of Genesis, and subsequently to ch. ix. v. 13.

ERRATA.

Page 63, *for* "Del Cemento," *read* "*The Del Cemento*"—being a Scientific Association.

Page 65, heading, *for* "NOT reflexible," *read* "MOST reflexible."

The note in page 115 ought to have been placed in page 56.



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INTRODUCTION.

THE failure of so many preceding *Theories* emanating from distinguished authorities, and ushered into notice with such sanguine expectations of their consistency, has induced a prejudice, almost insurmountable, even by those who possess the most patient spirit of investigation; and this naturally operates as an impediment to the impartial examination of a subject of GENERALIZATION, hitherto so barren of hope, and unprofitable to Science, notwithstanding its acknowledged and paramount importance.

There are perhaps some considerations that may render the present attempt, if not flattering to the projector, at least innoxious to others. First, that coming from the pen of one,* except by his practical pursuits, little known to the *scientific world*, no ill consequence in retarding the advance of Science, in its regular legitimate course of experimental agency, can be apprehended; and secondly, that however erroneous may be the principles now advocated, yet on their *bare* examination (if deemed worthy of that trouble) something of benefit may be by accident elicited (as our greatest discoveries are attributable to adventitious causes), or perchance it may move the master-mind of some eminent Philosopher† to enlist in the investigation, which may be productive of incalculable benefit.

* "Preservation of Timber from Dry Rot."

† Among the many eminent names to which I allude, both foreign and native, I venture to mention one, whose name, pervading Europe, has been received with that marked distinction so justly merited by a life of indefatigable zeal and undeviating perseverance in the promotion of Science—PROFESSOR FARADAY.

In directing our attention to the objects which surround us, on the surface of our habitable globe, we are forcibly impressed with astonishment at the *infinite variety* so uniformly displayed in the *Animal, Vegetable, and Mineral Kingdoms*, their beauty in formation, their relative dependence for support, and the admirable economy of arrangement, by which their mutual transition from one state to another is conducted, by a system of unerring laws, which preserve undiminished *ad infinitum* the *original principles* of which they are composed, we are lost in admiration of that *Sublime and Omnipotent Power* to which their *existence* is *referrible*, and on whose *will* their *duration* depends.

If we take of either the animal or vegetable bodies for analyzation, we find their original elements of composition (as generally known and admitted) do not exceed *four*.

On turning to those of the mineral kingdom, we are indeed astonished at the DISCORDANCE that appears in their *accepted* system of conformation, imputing the existence of FIFTY-FOUR ORIGINAL OR UNDECOMPOUNDED BODIES for such purpose.

Should we inquire of ourselves, Is *such* COMPLEXITY reconcilable with the *beautiful* SIMPLICITY so eminently displayed in the physical composition of ORGANIZED *bodies*? The reply will, it is presumed, be naturally in the negative.

The next question that would suggest itself is, in the establishment of a SYSTEM acknowledging the existence of so many *undecomposed bodies* as *original principles*, have chemists observed the needful precautions, to insure the absence of ERROR, by correct *analysis*, by securing the impossibility of *escape* of *any* of the probable component principles, by effectually and hermetically sealing the chamber or apparatus in which the experiments have been conducted, and by a minute examination of the *products*, to ascertain that the gas or elastic form into which the body under trial may have been in part or wholly converted, *is in itself* HOMOGENEOUS and DIS-

TINCT from ANY of the GASES already ESTABLISHED as ORIGINAL ELEMENTS.

Now, unless such is the case, how can a body be entitled to the term of ORIGINAL ELEMENT?

It will probably be found that in many of these experiments the bodies so termed have been unavoidably subjected to *high heats* in the dry or igneous process, or submitted to *electric* or *galvanic* applications, and that the RESIDUUM, ALONE, or in CONJUNCTION with a re-agent of known composition, used as auxiliary, has probably laid such claim to the notice of the operator, in the production of some *novel result*, that the portion *dissipated* in the process, or what may have passed off in a *radiant* form, has totally escaped cognizance, and has never been taken into consideration. This is not an imputation against the *operator*, whose views have been totally directed to positively *tangible*, or evidently *material* RESULTS.

Thus, in the experiments in proof on *carbon* to entitle that substance to the denomination it at present possesses, of an ORIGINAL or UNDECOMPOUNDED body, it is stated that CHARCOAL and the DIAMOND, when ignited in oxygen gas, are consumed, and the result is *carbonic acid gas*; that *charcoal*, or *pure carbon*, *per se*, when ignited in close vessels in vacuo, is not reduced except in *volume*, but rendered more condensed, and of an *intense black colour*. Sir H. Davy found that the *diamond* yielded a volume of carbonic acid gas equal to the *oxygen* consumed; that *charcoal* and *plumbago*, under similar circumstances (the latter *an acknowledged compound*), yielded *carbonic acid gas*, with a *minute portion* of *hydrogen*.

What allowance has been made, in the operations on the *diamond*, for the oxygen and hydrogen in their relative proportions forming the water of crystallization, or *for* what has passed off in a radiant state? None.

In the various systems which have been proposed on the subject of *Light*, in explanation of its *numerous* and *interesting phenomena*, however the eminent authors with whom they

have originated may have failed in the establishment of their *premises*, some *little additions* to our *acquisition* of information have been usually attained, always of importance to Science : occasionally a *hint* has been afforded which might lead to the right path to that desirable portal of knowledge to which the ardent inquiring eye of the lover of Science is ever directed, with the same anxious hope which usually animates the traveller, who looks over the interminable plain for some propitious landmark to direct his way. These are the happy contributions which become the solace to the laborious investigator, the welcome credence that assures him that he has not toiled in vain.

Such have been the inducements that have prompted the exertion of these humble efforts, yielding to the pleasurable hope of the only expected recompence, that they may not be vain ; that a *scintilla* of information, acquired by the investigation, may redeem both the trespass, and the presumption of the attempt.

In the year 1818, pondering on the *then* extremely complicated system of Physics, and finding that the discoveries of the philosophers of that day were rather yielding *fresh* additions to the list of *already acknowledged* elements, or undecomposed bodies, than reducing them in number (the latter in better accordance with true philosophy), I ventured to enter on the investigation of the subject: aware of my great deficiencies, so ill suited in every respect for a task of such difficulty, and without the command of the needful extent of chemical apparatus to test the several points with critical accuracy, I resolved to make my views, in their crude state, at once known to the most eminent philosophers of the day ; and I accordingly submitted a short prospectus, explanatory of the system I had to propose, for investigation, 200 copies of which were printed, and one forwarded to each of the gentlemen, the most celebrated for science at the time, entreating them individually to bestow some thoughts on the subject, and with the hope (as I

then expressed it) "to elicit from *their* more able and efficient efforts the complete confutation, the appropriate modification, or the ultimate establishment of the premises set forth."

A copy of this original prospectus, with its errors (since discovered and amended by me), is now to be found in the Appendix.

No notice being taken by any of the scientific parties (to whom they were addressed), no doubt from the natural credence, that I laboured under delusion, I have waited nineteen years, during which have been effected, with colossal strides in the advance of Science, many extraordinary and brilliant discoveries, reflecting due honor on the splendid abilities of the most persevering promoters of the general good, from whom they have emanated, and whose names will be recorded with just estimation in the annals of philosophy.

From the nature of many of those discoveries, so unexpected by the anticipations of analogous comparison, *an epoch has at length arrived*, when a subject of such doubt, of being worthy of consideration as the following, *may* obtain impartial and unprejudiced investigation.

As the sole object of the present Essay is the Elucidation of TRUTH, the *ordeal* of criticism will be most acceptable; and the substitution of any more rational and better supported system is not only courted, but its superior merits will receive the most willing and ready accordance from

THE AUTHOR.



THEORY OF LIGHT.

1. THAT *light* is a *ternary compound*, composed of the *three* simple *elementary principles*, or *undecomposed constituents* of *matter*, of which all other bodies in nature are formed.

2. By the convex lenticular prism of Field, *light* flowing from an emanating point or luminous body, as the sun, exhibits the three original colored rays of the spectrum, the *red*, *yellow*, and *blue*, from which all other shades of color are composed.

3. That such prismatic divisions of the *elements* of *light* determine the identity of its constituents into

The *Red Ray*;
Oxygen.

The *Yellow Ray*;
Nitrogen.

And the *Blue Ray*;
Hydrogen.

That the *three primary* colored rays possess peculiarly distinct and countervailing qualities, and on the proportions in which they are combined in matter, and the nature of the polarity exercised in their combination, the specific properties of the material compounds they produce are dependent.

4. That *light* combines with inert or fixed matter, not specifically or bodily, but partially, by the absorption of its individual or separate rays, electively, from existing laws of attraction, and such *transition* of the elements of *light* is as *constant* and *unceasing* as the *reconversion* of tangible or fixed matter is evidently *continuous* to the state of *radiancy*, or *light*.

5. That such changes of form are reciprocally exercised, and effect a complete and perfect *equilibrium* in the operations of nature, the supply in both cases being correspondent with, and governed by, the *necessity*, or *consumption*. *All solids* with which we are familiar, (the *metals* included,) *all fluids*, and the whole of the gases, *three only excepted*, ARE COMPOUND BODIES.

6. That these three gases are *oxygen*, *nitrogen*, and *hydrogen*; the elementary constituents of *light*.

7. Therefore 51 in number, of the 54 at present *acknowledged original constituents* of matter, are *compounds*.

8. That *carbon*, for instance, from its *color*, (*black*, formed by the union of the *three original* prismatic colors,) is composed of the *three original elements*, and that its being obtained from the combustion of organized vegetable bodies, by whose analysis it has long been established that they are principally constituted of the *three elements*, affords *primâ facie* evidence of its *compound* nature.

That the *diamond*, which is considered to be *pure carbon*, is not only combined with the water of crystallization, (*oxygen* and *hydrogen*,) but displays its *compound nature otherwise*, and has been pronounced on a late occasion, by an authority of great eminence,* as affording strong traces of its *vegetable* origin.

9. That the inflammation of the three original gases, in the following proportions, as to volume and weight, produce PERFECT WHITE LIGHT.

Oxygen :		Nitrogen :		Hydrogen :
wt. 16. vol. 5.		wt. 14. vol. 3.		wt. 1. vol. 8.

10. That the order of *polarity* exercised in the formation of *light* is *constant* and *invariable*; that is, by the positive pole of the one original element (*oxygen*) with the negative poles of the two other original elements, (*nitrogen* and *hydrogen*,) uniting at the centre of the *compound molecule*, or corpuscular atom of *light*.

11. That the reversion of matter from the *radiant* state of *light* to that of *fixation*, by chemical combination with bodies of palpable matter, is subject to a *diversity of polarity* governed by the nature of those bodies, which are endowed with certain influences of action dependent on their order of constitution.

* Sir David Brewster, at the meeting of the British Association at Liverpool.

12. That the *existence* of an *equilibrium*, as to the gradual transition and reversion of matter, to and from the *radiant* and *fixed* states, is not less consistent with its INDESTRUCTIBILITY, than that already admitted to exist in the daily formation of *water*, and the restoration of that body to its *original constituents* in the *gaseous state*.

13. That the health and vigour of vegetative bodies, as well as the colours by which they are adorned, are principally attributable to the transition of radiant matter to the fixed state.

14. As the *crystalline* forms assumed by bodies are governed by the number and position of their *original constituents*, and as no *homogeneous* body can consistently exhibit *such diversity* in its *atomical arrangement*, the assumption of such forms by the *metals* is *one* of the many presumptive evidences in support of their *compound nature*.

15. That as *all bodies*, whether of the *animal, vegetable, or mineral*, kingdom, (*as here presumed,*) are *compounds* formed of the same constituents, their peculiar properties and qualities *are not* to be considered INNATE, but are to be attributed in addition to *variation* in *proportion*, to a *modification of arrangement* inducing a POLAR influence, by which their passage to other stages of fixity is facilitated or impeded, and they are rendered applicable to *further* appropriate changes.

16. Thus matter is deleterious alone from an arrangement *contrary* to that *consistent* with *animal organization*, and not from qualities or properties peculiar to its constituents.

17. That when a *molecule* of light is formed, and occupies its place in a regular line, radiating from an *emanating* point, from whence *light* is *projected*, it assumes a polarity proper to a *compound sphere*, putting in action but the *two poles*, the positive and negative, at its *vertical* and *opposite surfaces*, while the *pole* of one of its original elementary atoms, (*hydrogen*), being from *local* position LATERAL, on being influenced by its condensation to assume a density equivalent to

that of the highest (*oxygen*), exercises for the time *no power of polarity whatever*.

18. That to equalise the density and pressure of the *molecules* of LIGHT, in the *radiant* and *visible* state, the *oxygen* occupies 16 parts in weight, the *nitrogen* 14 parts, and the *hydrogen* 1 part, in each spherical molecule. — See No. 6, Plate IV.

19. That when, however, a *compound molecule* of light is *relieved* from the consequent pressure and polar attraction of a *direct emanating ray* emitted by a luminous body, it is by the *expansion* of its *compound elements*, (proportional to their *natural densities in volume*,) UTTERLY CHANGED, exhibiting *one negative* and *two positive poles*, in such *angular positions* on its *spherical surfaces*, as to produce, under such circumstances, REPULSIVE forces which occasion its complete *insulation*. — See No. 5, Plate IV.

20. That the separation of the *individual* original constituents of *light*, by division of each compound molecule, constitutes the ELECTRICAL, GALVANIC, and MAGNETIC forces.

21. That the system of GRAVITATION is imputable solely to the separation of the ELEMENTS of LIGHT, and the accumulation of one species, the *positive (oxygen) in excess*, in a certain relative space or *hemisphere*, while the *negative (nitrogen and hydrogen)* occupy the *other hemisphere*, and they both form the *electric and magnetic envelope of our globe*.

22. That the position of the *positive electrical hemisphere* is always OPPOSITE the SUN, and that the *negative hemisphere* is deprived of the light of that luminary. But that our Earth, in its diurnal rotation, is *always changing position*, and that the portion of its surface which occupied the *positive electrical hemisphere* in the DAY, passes through the *negative electrical hemisphere during the night*.

23. That *such transitions* occasion the *continuous electrical currents* through our *earth*, which perform the *accustomed operations* of NATURE.

THEORY OF LIGHT.

24. That when the *equilibrium* is disturbed by alternations of consumption, from combination with fixed matter, or the resolution of bodies from a state of *fixation* to that of *radiancy*, the *phenomena of lightning* is rendered visible.

25. That the *Aurora Borealis* arises from the friction of laminar currents of the atmosphere passing each other in superposed strata, and at *opposite angles* of various degrees, and such currents being charged with *light* in a free state, or at large, the *separation of its elements* is first occasioned by such *friction*, and a subsequent union, or restoration of each abstracted portion of the *molecules of light*, takes place, and restores *quiescence by equilibrium*.

26. That the matter of *LIGHT* produces in *fixed* bodies all the phenomena at present imputed to *caloric*, which is *not a separate or distinct BODY, nor a cause*, but a *CONSEQUENCE* of the energy of action of the *primary constituents of light*, in effecting *their union* to produce *light*.

27. *Light*, as insulated molecules, pervades the entire of the atmosphere, but is rendered *visible only* during the *action* of a *radiating point* from which *additional or surplus light* EMANATES.

28. The *velocity* imputed to *light* in its passage through space, calculated at 192,000 miles in a *second of time*, may be rendered more easy of conception by considering that it is not meant to assert that one particle has been transmitted through such an *immense distance*, but that a *UNION of the molecules pervading space* has been effected by their *appropriate poles*, in a *LINEAR RAY*, within so short a period.

29. *NEITHER* of the systems of *UNDULATION* nor *EMANATION* can be *separately and distinctly established* to the prejudice or suppression of the other, but they are perfectly reconcilable as to their *conjoint action*, and that they *both* contribute to the *visible perfection* that exists in the *TRANSMISSION of LIGHT*.

30. The *limited rotatory motion*, imparted to the molecules of *light* while under the condensing influence of *pressure*, and

in *attaining* their *respective positions* for the *junction* of their POLES, when changing from the *insulated* to the RADIANT *linear state*, may exhibit *undulatory motion*, but the *projection* of REDUNDANT *light* from an *emanating point* is *essential* to produce IMPETUS, PRESSURE, and CONTACT.

1st. Light is a material compound, composed of the *three* simple elementary principles or undecomposed constituents of which all other bodies in nature are formed.

LIGHT is that *radiant* state to which fixed or inert matter is resolved. It is (as here presumed) a ternary compound of *oxygen*, *nitrogen*, and *hydrogen*, combined by one positive and two negative poles, in the centre of each atom, assuming a spherical corpuscular form; the primary molecules of which are readily separable from combination, and from their *minute* state are *most appropriate* to enter into new and immediate combinations with bodies of fixed matter, in which shape they reappear, displaying in the regular series of alternate transition all the beauty and variety visible in surrounding objects.

The *materiality* of light has been admitted since the days of Newton. Its properties with respect to vision and its particular laws, defined under the science of optics, it is not intended to discuss, although from its *chemical* relations, which are the more immediate objects of the present inquiry, the mention of *refraction*, *reflection*, *velocity*, &c., is unavoidable.

The sources of light are three: 1st. The sun, or its *atmosphere*, by direct emanation. 2nd. The other heavenly bodies, by reflection. 3rd. The resolution of *fixed* into *radiant* matter by combustion or decomposition; the electric or galvanic action.

Of the physical cause by which light is emitted by the sun, man is likely to be ever ignorant at this side the grave; it is numbered among the wise arrangements repressive of his

vanity; a lesson so powerful on the subject of the insufficiency of human understanding, that it should teach us humility. On this point it is philosophy to be *silent*, and to bow with submission to that Omnipotent Power by whose WILL *light was formed* and we are in being; but we may fairly investigate the effects of *light*, and judge of its *nature* as a body, by direct evidence, and by analogy, with the hope to elicit some benefit.

The triangular prism of Newton displays in its usual application, so universally known, that beautiful spectrum, which was divided by that eminent philosopher into what are generally termed the *seven prismatic colored rays*, (See Plate I, No. 1,) and which were for a long time supposed to be distinct and homogeneous portions of *refracted light*: these were afterwards reduced to *four* by Dr. Wollaston.

It has been, however, fully demonstrated that there are but **THREE** original homogeneous colored rays, *red*, *yellow*, and *blue*, by Sir David Brewster, whose investigations on the subject of *light* and its properties, unceasing and indefatigable for years, have been rewarded by his discovery of many most valuable and interesting phenomena, recorded in the works of that eminent philosopher, as well as in the various Transactions of the learned and scientific Societies.

It must be evident to an observer viewing the Newtonian spectrum, that except the red, yellow, and blue, all the other rays are not homogeneous; that when the *yellow* ray overlaps the *red* ray, it is gradually acquiring an intensity of tints of light-orange, dark-orange, and scarlet, till it terminates by an exposure of the red ray distinct; and that where the *blue* overlaps the *yellow*, it is *deep-green*, *light-green*, and very *pale-green* terminating in *yellow*; on the other side, the *blue* is first converted into deep or intense purple, and gradually softens down into *violet*, proving the want of distinct homogeneous intensity in all the rays except the primary *red*, *yellow*, and *blue*.

There are no *two* colors by which we can form any of the *three primary colors*, while we can produce *all shades* of *purple* and *violet* from *red* and *blue*, all shades of *green* from *blue* and *yellow*, all shades of *orange* and *gold colors* from *yellow* and *red*, and from the *three primary rays*, in given proportion, **BLACK.**

But if light is transmitted through a plano-conical prismatic lens, the angle of which is 23 degrees, it invariably exhibits in annular form, well defined, the three original colored rays of which light is composed. See Fig. 1. Plate II.

Mr. Field observes, page 217 of his *Æsthetics*, or *Analogy of Sensible Sciences*—"In the centre of a piece of white paper six inches square, form a black spot (one-tenth of an inch in diameter), place it upon the stand of a chromascope, opposite to the light of a window, and adjust the instrument in its vertical position, so that the spot may be close to and concentric with the *lenticular prism*, or *double convex prismatic lens*; then gradually sliding the tube upward, looking at the same time through it, the spot will appear to expand and be refracted into a beautiful annular colored spectrum, or aureola. When a black spot is made on a white or light ground, the rotation of the colors of the iris is blue, red, and yellow.—See No. 2, Plate I.

If, however, you place a white spot on a black or dark ground, the position of the colors is inverted, being red, yellow, and blue.—See No. 3, Plate I.

If now the double concave lenticular prism, Fig. 2, Plate III., be interposed between the chromascope and the spot, the *aureola* will be, by a *counter refraction*, reduced to the spot at its *centre*.

From the action of the *double convex* prismatic lens of Mr. Field on the *refraction* of the dark or black spot, it would seem that the *shade* is composed of the *rays* of *light* in such form of combination as to be *black*, analogous with *carbon*, as I am satisfied it will yet be demonstrated that *carbon* is a

COMPOUND, to which I shall presently refer, under the head of Solids. And the *black shades* which appear to *striae* the several parts of the spectrum, may prove to be the appropriate condition for the formation of *carbon*, and also may account for the *calorific rays*, as it may yet appear that such a condition of the rays, not being in the proper state to produce *perfect WHITE light*, may exert on the medium through which they pass, an energy of action *so intense* as to afford the sensation of *caloric* by the *motion* and expansion of its particles; I have therefore ventured the opinion, that *heat* is *but a consequence*, and not a distinct matter, and that such is the more evident by the resolution of bodies of greater fixity into *radiant matter* or *light*, as from the moment that *light* is rendered *perfect*, the sensation of *heat* which arose from the *energy* of *combination* totally ceases.

The *red ray*, as already proved by Sir H. Davy, possesses oxydating (oxygenating) and acidifying powers.

By the action of artificial or *terrestrial light*, the oxydation of metals is produced, and the oxides resulting exhibit, in a variety of instances, a *red color* where the oxygen is in maximum.

A mixture of chlorine and hydrogen acted more rapidly on each other, combining without explosion, when exposed to the *red rays* than when placed in the *violet rays*, but a solution of chlorine in water became solution of *muratic acid* most rapidly when placed in the most *refrangible rays* of the spectrum.

Puce-colored, *oxide of lead*, when moistened gradually acquired a tint of red in the *least* refrangible rays, and at last became *black*; but was not affected in the most refrangible rays.

The *oxide of mercury* became *red* in the *red ray*, which must have depended on its absorbing oxygen.

The *violet ray* produced upon moistened red oxide of mercury the same effect as *hydrogen gas*.—Davy's Elements of Chemical Philosophy, page 212.

The oxydizing power of the red ray effects the combination without explosion of the *chlorine* and *hydrogen*, (M. Gay

Lussac, Thenard, and Dalton) ; for explosion arises, as I conceive, from the presence of more elementary atoms of the same species than can combine at once with a lesser proportion of the elements of another species, or from the absence of the regular quantum of each element in a free state to produce *light*, and therefore explosion is rendered evident from the obstruction of the regular system of *polarity*, which such a *confusion* in the *position* of the *poles* of the *corpuscles* must naturally occasion.

'The conversion of an aqueous solution of *chlorine*, to a solution of *muratic acid*, by the power exerted by the *blue*, or more refrangible rays, clearly proves their *hydroginating qualities*.—M. Ritter, Dr. Wollaston, M. Berthollet, and Dr. Young. While the *oxygenating* powers of the red ray are shown by its converting the *oxide* of mercury *red*—and its similar action on puce-colored oxide of lead.—Sir H. Davy.

The red ray is identical with the oxygen discharged from the positive pole of the galvanic battery, and with positive electricity, and with it is to be found the power of ignition producing, as it is called, *combustion*, and therefore it is deemed a supporter of combustion when applied to a body containing the other elements of LIGHT; but the fact is, the presence of the three original elements is essential to the production of PERFECT LIGHT.

It is found that when the oxygen and hydrogen gases are ignited, they produce much *heat*, and LITTLE *light*. Why? Because *nitrogen* is *absent*. Present therefore to an ignited stream of these gases a piece of *lime*, being an *alkalescent earth*, and containing consequently *nitrogen*, and the most *bril- liant* and perfect TERRESTRIAL LIGHT is formed, of an *intense white* and *vivid brightness*, and the nearest approximation yet achieved to CELESTIAL LIGHT, and divisible, *like it*, into the *three prismatic colors*, *red*, *yellow*, and *blue*.

In the patent process for producing an *economic light*, from the refuse of combustible matter (as practised by the Messrs. Enderby, at their manufactory at Greenwich), by a current of

atmospheric air, I observed very particularly whenever an undue increase of pressure was put on for the moment, *experimentally*, that there were exhibited the distinct colors of *red*, *bluish*, *purple*, and *yellowish light*, forming separate portions of the volume of *flame*, but that when the pressure was adjusted, as is usual, and moderated to a regular proportionate supply, an excellent intense *white light* was produced.

Such diversity of color in the flame occasioned by the excess of velocity of the stream of atmospheric air, evinced the peculiar color of the *oxygen red*, of the *nitrogen yellow*, and of the *carbon*, a composition of the *three original elements*, produced from the residuum of the inflammable bodies submitted to ignition, which when first ignited burned with a dull and deficient light, full of *intense smoke*, which latter was immediately dissipated, and the flame expanded and projected four feet high, affording a most brilliant *clear white light* from the action of a very *moderate stream of atmospheric air*.

As a proof of the identity of the red ray with *positive electricity*, Mr. J. H. Abraham, F. L. S., of Sheffield, informed me that in trying some experiments on *lateral discharges*, and on the gradual and silent discharge of a battery or jar overflowing with *positive electricity*, he obtained sparks seven inches long of a beautiful *vivid rose-colored light*, while I have observed from *negative electricity* the most beautiful light-green color from a galvanic arrangement operating to produce a *magnetic rotary power*.

The accordance of these facts would show first that *oxygen*, the *red ray*, *positive electricity*, and *positive galvanic power*, with *inflammation*, are IDENTICAL.

And that *nitrogen* and hydrogen, the *yellow* and *blue rays*, affording *magnetic power*, the *negative electricity* and *galvanic negative essence* are also identical.

That by their union they form *light*, and by their accumulation to the surfaces in the pervasion of masses of matter, they may (and in my opinion do) by their opposite states produce

that peculiar species of attraction, called GRAVITATION, as I shall hereafter attempt to demonstrate.

Oxygen is well known to be a *colorless inodorous* gas, which is nearly insoluble in water, does not change the color of tincture of litmus, has no effect on lime-water, and being *homogeneous* and effectually *resisting decomposition*, is fairly entitled to the denomination of an ORIGINAL *element*—its specific gravity is 16, as compared with hydrogen.

It is always found combined with other matter and never discovered *originally in a SOLID STATE*, which is an additional proof in favour of its elementary nature. The *yellow ray*; *nitrogen*, forms a colorless inodorous gas, it is incapable (*per se*) of supporting combustion, but in union with the *two* other gases, *oxygen* and *hydrogen*, produces the *most vivid and brilliant light*; its specific gravity is as 14 to 16, or 3.5, to 4.0, compared with *oxygen*.

The nitrous oxide gas, 1 volume of oxygen to 2 of nitrogen *supports combustion*; nitric oxide or *nitrous gas* is colorless, but when allowed to *mix* with atmospheric air, produces by union with *oxygen* brilliant RED *fumes*.

The compounds of *nitrogen* are apparently *alkalescent*, and the effects of such compounds produce a *yellow color*, unless when supersaturated or overpowered by a maximum of oxygen or hydrogen; the first as a direct acid from combination with *oxygen*, the second as a direct acid by being compounded with *hydrogen* and a minute quantum of *oxygen*, forming first CHLORINE, which from its peculiar *greenish yellow color* exhibits an evidence of its *compound nature* from the yellow (nitrogen) ray and the blue (hydrogen) ray, and muriatic acid from an *addition* of *hydrogen*.

Now the effect of nitric or nitrous acid on the fibrine of animal matter, (the skin of the body,) is to produce a *yellow color*, while the action of *chlorine* is to *bleach* or discharge all colors from the surface and texture of BODIES.

The power to produce evanescence in colors, exerted so

effectually by *chlorine*, is an *evidence* of its correspondence, by analogy, with that of the *yellow* and *green rays*, the latter being a compound of the *yellow* and *blue rays*, and as *sulphurous gas* has very *similar properties* of *bleaching*, and indicates its composition from *nitrogen* and *hydrogen*, as its predominant principles, *muratic acid*, being of nearly the same composition, varying (as it is presumed) in its proportions, is incapable of dissolving *sulphur*, being replete to SATIETY with *those elements*; but AQUA REGIA, composed of *nitric* and *muratic acid* from its accumulated *oxygen*, readily converts *sulphur* into *sulphuric acid*.

Chlorine gas can by great pressure be reduced to a *dark yellow oily LIQUID*, heavier than *oxygen gas*, as 9 to 4.

Now we have no instance in which by experiment we have been able, by pressure, or any means yet applied, to reduce *oxygen* gas to a *liquid* state, nor *hydrogen* nor *nitrogen*; as it would appear, that perfectly *original elements* are quite incapable (*per se*) of assuming either the *liquid* or *solid forms*, and that all liquids and solids must, consequently, be *compounds*; and that, where *liquids* and *metals* exist, *hydrogen* must be an essential ingredient of composition, and in excess affording *fluidity* to the one and *malleability* to the other.

That where *alkalescent* matter exists, the *yellow*, or *nitrogenous ray* (that neutralizing and counteracting power to the acid properties of *oxygen*, or the *red ray*) must be a *necessary* constituent.

That where the dry earths or metallic *oxides* exist, and also *acids* generally, *oxygen*, or the *red ray*, must be present, and in many cases, *predominant*.

The power possessed by *iodine* to *bleach*, and its resemblance to *chlorine*, and the color and odour of *iodine* in a gaseous state, would induce the belief that it is a *compound* of *hydrogen-blue* and *oxygen-red*, in small proportion, giving a *violet* color. With *starch* it forms a *blue* compound; and the nature of its other compounds would evince, from their similitude with

those of CHLORINE, that *it* also holds a minute quantity of the YELLOW (*nitrogen*) ray in its *constitution*.

Bromine would appear to be somewhat analogous to *chlorine*; it also *bleaches*, and may have the *three* elements in its composition from its color, *reddish-brown*, when boiled, exhibiting the *red* and *yellow*, and from the *hyacinth-red solution* a portion of *hydrogen*, which, on addition of *water* as a *menstruum* of solution, containing the *red (oxygen) ray* and the *blue (hydrogen) ray* in EXCESS, affords the *red hyacinth color alluded to*.

The three *alkalies* are composed of *nitrogen*, the *yellow ray*, with various portions of the other rays.

Sodium inflames in atmospheric air. When thrown on the surface of water it decomposes with a hissing noise; disengages *hydrogen*, occasionally exhibits a *yellow flame* when nearly in contact with the *sides* of the vessel, or on its *first direct contact* with the *water*. But it *burns* on *hot water* with a *bright yellow light*.

Sulphuret of sodium.—Sulphur and sodium, when heated together in a glass tube, exhibit much *heat* and *light*, and form *sulphuret of sodium*.

Sulphate of sodium, mixed with *charcoal*, form an impure sulphuret of sodium. It is semi-transparent, and of a *flesh-red color*. While *sulphur*, boiled in a solution of *caustic soda*, affords sulphuret of soda, in solution of a *greenish-yellow color*.

Nitrate of soda is used to give a *yellow color* to the *flame* of fireworks.

Dr. Clark has observed that *phosphate of soda*, when *ignited*, acquires, as a *pyro-phosphate*, *new* properties; and when re-dissolved in water, *crystallizes* in a different shape, and with a different number of atoms of water, from the common *phosphate*. Its solutions, also, when mixed with solutions of *silver*, yield a *white* precipitate of neutral phosphate of *silver*; whereas, the *common* phosphate produces a *yellow* precipitate of sub-

phosphate of silver. See Mr. Griffin's "Chemical Recreations and Romance of Chemistry," which contains much accurate and valuable information.

Borate of soda turns vegetable *blues* GREEN; it is a common principle of all *alkalies*; and they have a discharging power on many colors, and also by their combination with *mineralized oxides*; as fluxes *contribute* much from the introduction of the *yellow (nitrogen) ray*, to *fuse* and *separate* the *metals* in combination, neutralizing the oxygen.

Potassium is inflammable to a high degree. Heated in *oxygen* gas, it burns with a brilliant *light*, and an intense heat; when thrown on the surface of water it acts with great violence, evolving *hydrogen*, which spontaneously inflames in the atmosphere, communicates combustion to the *potassium*, burning, while swimming on the water, with a beautiful *violet-red colored light*, which is derived from the *oxygen* and *hydrogen* of the water; the residue of the oxygen combines with the potassium and is dissolved, forming a solution of potash.

It spontaneously inflames in *chlorine* gas, and burns with brilliancy; this would indicate that *chlorine* is a compound of the *yellow (nitrogen) ray*, the *blue (hydrogen) ray*, and that the presence of *oxygen* in the atmosphere supplied the requisite portion of *that element*.

From the powerful action of potassium on *all fluids* containing *water*, *chlorine*, or *oxygen*, and its general powers of chemical combination, Mr. Griffin compares it to the *Alcahist*, or *Universal Solvent*, so much in request by the *alchymists*.

The solution of mineral chameleon, *manganesate of potash*, producing remarkable changes of *color*,—from deep green solution, to the various shades of *green*, *blue*, *purple*, and *violet*, terminating in a splendid *red* color.

It first contains an excess of *alkali*, which, with *hydrogen*, appears *green*, on exposure to *atmospheric air*; it absorbs *carbonic acid*, which decomposes a portion of the *manganesate*, produces *carbonate of potash*, a precipitate of *hydrate of man-*

ganese, and a new salt, *super mangesate of potash*, which is the compound that exhibits the RED-coloured solution.

"It contains *half* as much *more oxygen*, twice as much *manganese*, the quantity of potassium remaining the same." See Griffin's *Chemical Recreations*, page 184.

The *blue (hydrogen) ray* is the most *refrangible*, most distended, and consequently of *least density*; which is (*by analogy*) to the *red ray*, as 1 to 16; to the *yellow ray*, as 1 to 14; or, in similar ratio, as *hydrogen* to *oxygen* and *nitrogen*; and is, therefore, the *COOLEST* portion of the spectrum from its *comparative reduction of pressure*.

The hydrogenating power of the *blue, purple, and violet* portions of the spectrum, has been proved by Davy, Ritter, Bertholet, &c.; and their magnetic power by Moreschini.

Hydrogen is (as is termed) combustible, but *burns* with a *very faint light* (in the *day-light scarcely visible*), mixed with *oxygen*: on being inflamed it *explodes*, and combining, produces *water*, as discovered by *Cavendish*—and confirmed by successive philosophers, as is at present perfectly familiar to us.

The specific gravity of *hydrogen* is .0625 oxygen being 1,000, or 0.25 oxygen being 4.0 according to *Griffin*, which appears a preferable scale for comparative densities.

Hydrogen forms, notwithstanding its *levity*, a *ninth part* of *all water*, and is an important ingredient in a vast number of chemical compounds, of great energy.

It is an essential constituent in all bodies of the *animal, vegetable, and mineral* kingdoms.

In addition to the fact, that there cannot exist any *liquid without the presence of hydrogen*, neither can there be (as here presumed) any *metal* possessing *malleability* without *its* being an *identified constituent*, and in *excess* above the equivalent proportion of *oxygen*. When, however, *oxygen* gains the *predominancy*, the *metal* becomes an *oxide (earth)*; or if a *liquid*, an *acid*.

When *nitrogen* (the *yellow ray*) obtains *pre-eminence*, the *material* becomes ALKALESCENT, or if an *acid*, obtains the great and extraordinary qualities of a *universal solvent*; as *aqua regia*, composed of *two acids*; which, when united, as the *nitric* and *muriatic* acids, give the excess of *nitrogen* as a powerful agent from *mutual contribution*; thus *gold*, which resists *either acid separately*, submits to their *combined* and *paramount power*, when they form *aqua regia*. And, on the same principle, *gold* resists the action of *common terrestrial light and flame*, being formed of oxygen, hydrogen, and CARBON; the latter being a *compound substitute* for *nitrogen*, which is the *indispensable, controlling, and solvent constituent* in *celestial light*; the *solar rays*, condensed.

Hydrogen, in its gaseous state, extinguishes all *ignited* bodies; but such power arises solely from its want of immediate combination by the exercise of the *appropriate polarity* with the *other original elements*, which constitute LIGHT.

If, for instance, *oxygen* and *hydrogen* are mingled by a *jet*, from *two* receivers, or vessels, holding *each gas separately*, the *flame* and *light* are *very feeble*; but the HEAT *very INTENSE*. Yet let *carbon* be present as *carburetted hydrogen*, or *sulphur* as *sulphuretted hydrogen*, or *phosphorus* as *phosphuretted hydrogen* gas, the *light* is much more perfect. But if the stream of the two *simple gases*, *oxygen* and *hydrogen*, be thrown on a piece of *quick-lime* (*alkalescent earth*), the LIGHT is *so intense*, that the organs of vision cannot sustain its power, or rest upon it; being the most perfect approximation to *celestial light* yet discovered; affording to the *prism* all the *colors* of *refracted light*, in the most VIVID SPLENDOR.

Phosphorus obtained from *animal matter*, (*bones, &c.*), appears to be a body of fixed matter, in such a state, as to possess the power spontaneously to assume the *radiant form* of *light* with *great energy*.

It must be a compound of matter in *both states*, of *fixity*, and *radiancy*, intimately combined, possessing *such polarity*.

in its corpuscles, as to facilitate immediate resolution into the *radiant state of light*.

It is the *link* re-uniting *matter* in *both* its *states*; for we observe links of connection between all bodies of the *animal*, *vegetable*, and *mineral* kingdoms, and cannot deny the existence of similar points of contact and union between the solid, fluid, gaseous, and radiant states of matter.

The power of *easy ignition* depends on the *appropriate state* of the *polarity* of constituted bodies, to resolve with facility to the radiant state of *light*; and such bodies are denominated *inflammable*.

But the presence of free *oxygen*, composing *in part*, or *wholly*, the *medium* of operation, is necessary. For OXYGEN is POSITIVE ELECTRICITY, and exerts its power as fully in the promotion of that energy of action, among the atoms of matter *about to be resolved* into the *state* of LIGHT, and affording thereby the *sensation* of *caloric*, as a *consequence*, as does *negative electricity*, being the combined power of *nitrogen* and *hydrogen*, to produce *magnetic affection* in the act of its *continuous union*, with *oxygen*, or the *positive* electricity. This constitutes that sublime effect called GRAVITATION according to my views.

In support of this opinion I beg to state an hypothesis, as follows: Suppose the SUN and its *atmosphere* are in a *negative state of electricity* towards our EARTH, and the other *planets* of our *system*, that the *hemispheres* of our *earth* and of the *planets* *always immediately in opposition* to the *sun*, are in a POSITIVE *state of electricity*, and consequently are *attracted* by the SUN; and that they are severally protected in their orbits by having received a *velocity* of *motion* respectively and *proportionally great*, to preserve their *equilibrium* in the most just precision, and to retain them in their *continuous movement*.

That our earth, for instance, (as an example, in all other cases,) in turning on its *axis* in *diurnal* rotation, is *always*

changing its surface in direct opposition to the SUN, but that the *electric hemisphere* in the *positive state* still holds its *position*, so that *that portion* of the *earth's surface*, which was *positive* in the *day* becomes *negative* in the *night*, and thus *continuous currents of electricity* pervade the *globe*, or its *surface to a certain depth*—affording all those *compositions* and *decompositions*, those *actions* and *reactions*, and *transitions* from one state to another, so truly necessary to perfect the operations of nature.

Suppose that the surface of the *moon*, in direct opposition to the *sun*, is *always positive*, and that she is likewise *positive* to the *negative hemisphere* of our earth, *when opposite thereto*, or when in *other circumstances*, always retaining her *positive electrical hemisphere towards* the SUN, she observes a *modified gradation* of her *electrical state*, in reference to the *earth's surface*; when visible *by day*, *for instance*, may she not move with an accelerated motion at particular periods, subject to the increased influence of the effect of GRAVITATION, OR MAGNETIC ATTRACTION?

Now, I consider that the total surface of the hemisphere of our *earth*, exposed to the opposition of the *negative electrical power*, or *magnetic attraction* of the SUN, is not absolutely in *every part* and *position* POSITIVE, but that it is constantly varying in the different localities, from the *electrical state of the atmosphere*, which is *capricious*, or *subservient to circumstances*—but I contend that the *main average* affords *plus*—or an *excess* sufficient to *secure* the mutual *magnetic attraction* exercised by the SUN and the EARTH towards each other; and that the same law governs the other *planets*, and their *satellites*. If you can, (as has been repeatedly done by *Professor Faraday*, *Professor Ritchie*, and others,) create an *immense magnetic power*, capable of sustaining *tons in weight*, by the simple application of continuous streams of almost imperceptible electricity, flowing *positively* and *negatively*, from the respective poles of a *galvanic battery*; and that on separating the points

of contact of the platina wires (at which alone it is visible), and by which the re-union of the electricities had been effected, the power of sustaining the *weights immediately ceases*;—I would ask, do not more than analogous probabilities exist, to countenance the opinion that the combination of the two electricities (as they are called at present), is the *cause* of that *species* of *attraction* which may be termed GRAVITATION; and it may be presumed to follow, that *the* electrical forces are produced by the separation of the *constituents* of LIGHT, and that their *re-union* produces the *phenomena* here described?

CARBON is denominated and considered in all chemical works as an *original undecomposed body* or *element*.

For the following reasons, I conclude it is a *compound*. First, that it has never yet been reduced to the state of a *homogeneous gas*; that it is generally procured in the form of *charcoal* from *organized vegetable bodies*, which are known by analysis to be absolute *compounds*; that it is the residuum (and in great bulk) of such bodies submitted to *ignition*,—that its colour under such circumstances is *black*, which may be composed of the three primary colored rays already described. Secondly, that *carbon* in the state of the *diamond*, accompanied by its water of crystallization, cannot be resolved otherwise than by ignition in *oxygen gas* into *carbonic acid gas*. Why not into CARBONIC gas?—*if an original element* it ought to be so converted, but it resists (or as yet has done so,) all the powers of analysis we have been able to bring against it.

The learned President of the Section A,* for mathematics and physics, at the late meeting of the British Association at Liverpool, informed us of his opinion that the *diamond* was produced from a vegetable jelly, assuming a crystalline form, but appearing to have laminar coats which indicated a confirmation of his views as to its vegetable origin.

I am most ready to accord in the opinion of the learned

* Sir David Brewster.

President of its *vegetable origin*, and when we have already had proof that *gold* has been obtained from the ashes of incinerated vegetables, and that other metals, *iron* for instance, has been produced by similar materials, and also from other organized bodies belonging to another (the animal) kingdom, and these *metals* and the *diamond* are still retained in the list of *original elementary bodies*, we have no reason to be sceptical on the subject of the *vegetable* origin of the *diamond*. Crystals and glass are both transparent, they are *known compounds*, and why may not be the *diamond*, whose refractive power of *light* is so well established, and if of *vegetable* conformation, why not partake of *some*, or *most*, nay, *all* of the *constituents* of *vegetable matter*? *Glass* holds in its composition the vegetable and mineral alkalies, and silex (a vegetable product), and *metallic oxides*; and *glass* forms a very fair imitation of the *diamond*, and holds a ratio of comparison *somewhat inferior* to that of *terrestrial* with *celestial light*. It wants two or three material essentials, brilliancy and adhesive power, in its particles.

With respect to *adhesive attraction*, it does not appear unreasonable to suppose, that a *solid body*, if formed of but *one original elementary constituent*, and that *each atom* of such *constituent* can only be retained by the *union* of *opposite poles*, (the *positive* and *negative*,) supposing the formation to commence with a *central nucleus*, and radiating, *ad finitum*, to the extremity of the *exterior surfaces*; or, supposing them to be united in *striated lines*, *laminarily*, I ask, is it reasonable to consider that the *lateral attraction* of *cohesion* can have a chance of being *so perfect* as in a *compound* of *three* or *more constituents*, each *compound molecule* of which may exert on its *lateral surfaces* certain attractions from the *polarity* of its *original atoms towards each other* LATERALLY,—for, as the constituents of compounds forming *fixed bodies*, are not confined to the arbitrary law which appears *unchangeable* in the *constitution* of *light*, but are left at liberty to unite with a *va-*

riation of polarity in the arrangement of composition, and to which latitude of *variation* is to be fairly imputed the *change of quality*, in the *compound* influenced by change of the *relative proportions* of the *constituents*, it may be rationally assumed that the *polarities* of the *compound* molecules of *bodies* of the GREATEST FIXITY and COHESION, may exercise, in the conformation of *alternate atoms*, such a *change of polarity* on their *lateral surfaces* as to induce a *lateral attraction equal* to the *vertical attraction*, and that when such *lateral attraction* is *absent*, the body has *not tenacity* but is *frangible*, or easily separated by a slight *mechanical force*?

Let us examine known and acknowledged compound bodies, in reference to *change of quality*, merely from a difference of *proportion* in the original constituents, which difference must inevitably have also occasioned a *change* of the *polarity* as to some of the constituents.

SUGAR.	ACETOUS ACID.
28 Carbon.	50.224 Carbon.
8 Hydrogen.	5.629 Hydrogen.
64 Oxygen.	44.147 Oxygen.
<hr/> 100	<hr/> 100.000

All formed of the same elementary constituents.

In reference to adhesion I beg to observe, that I have assayed an ore containing *copper*, *zinc*, and *iron*, mineralized with mica, schist, sulphur, argillaceous earth, and quartz,—to which I applied the black flux, and with the usual heat of an air furnace, and in a Hessian crucible, I obtained a large metallic result, of a dark iron-grey color, with perfectly bright surfaces, *which evaded all the power* I was capable of applying : with a *huge sledge* on a smith's anvil, it was impossible to break it, or make the smallest impression on its surface; it came out from the ordeal unhurt, exhibiting the greatest power of adhesion and proving the effect of combination of many constituents, and such compound evincing the *most obstinate lateral* and *vertical adhesion*.

While I submit this fact as an example, it must be observed that I afterwards operated on the same mineralized body with the appropriate agents to obtain the metals in a separate and pure state, which proved satisfactory.

If we reflect for a moment on the necessity for *lateral cohesion* as an *indispensable requisite* in all *solids*, and that *cohesion*, *vertical* or *lateral*, must, and can only, be *induced* and *sustained* by the *union* of the *poles* of the *atoms* of an original element in *opposite states* of electricity, one atom must present its *positive* pole to the *negative* pole of the next atom, and so on in regular succession; and consequently, *if those poles* are the only *points of chemical union* or *adhesion*, the *lateral surfaces* of such atoms cannot exert any attraction whatever on the surfaces of similar atoms whose poles are already united to others *vertically*: therefore the *aggregation* of *molecules* of one *simple elementary body* cannot be expected to constitute a *solid*, and consequently *all solids* must be formed of *two* or *three original elements* in equal and various proportions, or in conjunction with *one, two* or *three compound molecules* formed of the same original elements, by which means the *compound molecule* of the *solid body* will display in the first place *vertically* the *positive* and *negative poles* of the compound *molecule so formed*, and next on the *lateral sides* will exhibit *certain poles* of the *several atoms* which are the opposite poles of those engaged by contact in the centre of the *molecule*.

From such arrangement it would be reasonable to conclude that the *first* compound *molecule* of a *solid* is in many instances a *nucleus* on which the other molecules form by aggregation—and that supposing the compound molecule to be *ternary*, and that the *solid* assumes the *crystalline form*, it would naturally exhibit the *tetrahedron*, if composed of the *three original elements*, the *simple prism*, if formed of *two* original elements and one compound molecule, and the cube if a *quaternary* compound molecule, which being originally *spherical* submits to *compression* “like the *pristine cylindrical form* of the

honeycomb, assuming the hexagonal arrangement," so convenient to the economy of space, so accurately described, in his lectures before the College of Surgeons, by Sir Antony Carlisle, 1818.

The development of *particular forms* in the *crystallization of saline bodies*, exhibits the undeviating prevalence of an *innate law* of conformation: thus Epsom salt (sulphate of magnesia) assumes the *four sided prism*: common salt, muriate of soda, the *cube*, nitre (nitrate of potass), *six-sided prism*, and alum, sulphate of alumina, *octahedria*, &c.

The natural assumption of the *spherical form* by all liquids, and all metals in a state of *fusion*, indicates that the *sphere* is the primary form of the atoms of matter, and the comparative volume of such spherical atoms with each other correspond in a ratio with *their densities respectively*; thus the *SPHERICAL drop* of water is of proportionally greater bulk than that of sulphuric acid, or mercury, &c.

With respect to the transition from the *sphere* to the *cube* or angular form in *solids*, and the exertion of the attraction of cohesion of one cube, &c., to another, *vertically* and *laterally*, it must depend on the opposite states of the electricity of the *surfaces* towards each other; the points of original *combination* are the *poles* of the spheres, but *once joined* and having assumed, as to the corpuscles, the *form appropriate*, the *electrical influences* appear to extend *over the whole of the surfaces in contact*, producing moderate cohesion.

The depositions of congealed water on glass windows being sometimes *arborescent* and varied in a most beautiful (but to us apparently irregular and capricious) shape, must yet be governed by *electrical influences*, modified by the breezes by which they are usually accompanied.

The electrical currents in mineral strata seem also to produce similar developments in the conformation of native metallic depositions.

I observed many years since some curious specimens of

native copper at the mines of *Ballymurtagh*, in the county of *Wicklow*. At the depth of about 300 feet, in cutting a drift from south to north, to meet the valuable lodes of copper ore, to the west of the old works, a fissure was discovered running diagonally across the lodes, and bearing about north north-west, while the lodes ran from east north-east to west south-west and were *three* in number perfectly parallel with well-defined walls, but varying in their *dip*; so that the most *southern*, having less *head*, or being *more perpendicular*, unites with the others at given depths, the mineralized strata, hard killas, or argillaceous ground with mica schist, and mineralized sulphur. The fissure was filled with black oxide of copper granulated like coarse gunpowder, and mixed with quartz crystallized like very large sand. The fissure was frequently closed with a large solid deposit of quartz, in the body of which we usually, and almost on every occasion, found *cavities* of about *eighteen inches high, six to nine inches wide, and from two to three feet in horizontal length*. These *cavities* were surrounded by quartz crystallized in a beautiful manner; they were also usually *half full* of quartz in loose detached crystals, *with very small portions* of oxidized copper, but having many beautiful bright specimens of *native copper*, in a perfectly *pure metallic state*, some of which were *arborescent*, like the heath, with here and there a few cubes of native copper attached. There were also some specimens in the form of flat narrow riband, about the tenth of an inch wide, and eight or nine inches long, the thirty-second part of an inch *thick*, having *at regular distances*, of about the tenth of an inch, the most *perfect cubes* of nearly one-tenth of an inch square, all connected with the flat or riband-like base. They were of the brightest rose colour, and in the most brilliant state as to their surfaces; and on exposure to the atmospheric air resisted for some days the usual oxidation, and when cut they were found to be *pure copper* in a *solid state*. It would appear that where the *oxide of copper* was in abundance the *native copper* was not to be found in the open parts

of the fissure ; but, on the other hand, where the *native* copper was in quantity in the *closed cavities*, surrounded by quartz, scarcely could we find more than partial traces of the *oxidized* copper ; the other parts of the cavities were filled with water, and saponaceous matter resembling silex.

The practical researches of *Rome de Lisle* and *Abbé Haüy* have done much in ascertaining the external forms of crystals : the latter had assumed the existence of six *primitive forms*, from the combination of which he supposed the *secondary* crystals may be produced ; he finally reduced them to three, as before observed. First, the tetrahedron ; second, the simple prism ; third, the cube. These appear to be the *ultimate forms* assumed in a compressed solidified state ; but the original must have been the *spherical*, assuming the spheroidal and ellipsoidal shape, according to the nature of the compound molecule, and resolving itself into the tetrahedron, the simple prism, or the cube, according to the diversity of the compound. Dr. Wollaston has assumed the primary molecules to be the *sphere*, the spheroid, and oblong sphere, or ellipsoid.

The extraordinary and beautiful parallel between the chromatic series of colors and the diatonic system of the musician, with their several relations, accordances, and coincidences, so ably described by Mr. Field so far back as 1819-20, in his "*Æsthetics, or the Analogy of the sensible Sciences*," is worthy of the deepest attention, as well from the admirable facts in which it abounds, as from the body of profound and logical reasoning, in his own peculiar felicitous style, displaying the erudite and accomplished philosopher, and the inexhaustible powers of a comprehensive mind.

This parallel between color and sound corresponds in a remarkable manner with another the *tones* afforded by glasses, and the *radii* exhibited on the surfaces of the water with which they have been attuned, as described by Mr. Goldsworthy Gurney in "a course of lectures on chemical science delivered at the Surrey Institution, and published by Whittaker in

1823"—to which I beg to refer for this and many other valuable facts and observations.

Mr. Gurney states, "that having filled a large goblet with two-thirds of water, and producing a tone in the usual way, with the hand previously wetted—4 points only of the circle of the glass became *agitated*, and these of *equal distances* from *each other*."

"This is called the simple or fundamental tone, when by vibration, *four distinct radii* are seen on the surface of the water."

"When the fifth from the natural tone is produced, on the same glass (viz. 2 to 1) there will be 6 *points of vibration*, and 6 *radii*."

"But when the vibrations combine in odd numbers they give 5 radii, and consequently angles of 72° ."

"If now you raise the tone to the octave, 8 points of *agitation* will be *distinctly seen*."—See Gurney's Lectures on Chemical Science, pages 96 and 72.

He also observes, page 93, that elements in chemistry combine 1 to 1,—1 to 2,—1 to 3, &c., constituting *perfect compounds*: so also musical vibrations combine 1 to 1, 1 to 2, 1 to 3, constituting *perfect chords*, or *concord*s.—Other substances in chemistry combine in the proportions of 3 to 2,—5 to 3, &c. constituting *less intimate compounds*: so also in the vibrations of sound, they combine 3 to 2, 5 to 3,—forming *thirds*, great *sixths*, &c. which are less perfect chords; and so on through the gradations of harmony of tone—exhibiting a great analogy between the *laws* by which they are respectively governed.—Certain tones are also produced by the ignition of *gases*.

The inference to be drawn from both these parallels would seem to establish that there *appears* to be a *direct coincidence* between the *colors* afforded by *light*, and the *modulations of tone*, and between the *sounds* produced by the *vibrations of glass vessels* holding water, and the *corresponding radii* exhi-

bited on the surfaces of the water they contain, proportional in *number* to the *symbol* of *intonation*,—showing the *analogy* between *color*, *tone*, and *form*, and that they seem to define, by such coincidence, their respective dependence as to their production on *elementary constituents* perfectly *similar* in their *properties*.

Although the intonations afforded by the ignition of carburetted hydrogen gas may be imputable to other causes, it may be right to notice them.

Mr. Gurney explains, pp. 302-307, the results of his experiments on his blow-pipe when using carburetted hydrogen gas, that having first produced by a regular moderate pressure a perfect white light, that by increasing that pressure gradually to a high degree, he was able to shew the light assuming the several prismatic colors in rotation thus:—first, near the orifice of a jet 1-16th of an inch diameter, first, *vivid red*, then *yellowish red*—next, *yellow very distinct*—still increasing the pressure a tint of *green* appeared; and lastly, a most beautiful and PERMANENT BLUE. On gradually removing the weights from the gasometer, by which the pressure was reduced, the colors passed again inversely through the several changes until the *bright white flame* appeared as at first.

Mr. Gurney found the heat of these colored flames respectively corresponded with those produced by the prismatic colored rays of solar light.

On holding a coil of steel wire in the blue violet flame, it assumed a bright white heat, and with a view to *extinguish it* by mechanical pressure by placing further additional weight on the gasometer, to his surprise, instead of cooling, it instantly assumed a bright appearance, and *fused* into globules in the most beautiful manner possible. Mr. Gurney, page 306, states, on placing a platina bar in the bright light, at the extreme end of the flame, most distant (10 inches) from the jet, he could not increase its temperature above the red heat, but on moving it gradually towards the jet, its ignition increased brighter in

gradation, until at length having reached within *half* an inch of the orifice of the jet, it fused and ran down in globules.

He observed the flame was hollow at that spot, and the platina had reached the dark portion of the flame when it fused.

Now this is a confirmation of what I have observed, that where *light* is perfect, *heat* is decreased and terminates, and that it is only in the reduction of *fixed matter* to its original elements from the solid to the liquid, and thence to the gaseous, the *appropriate condition* for *such elements* by their union in the *necessary order* of *polarity* to form *light*, that HEAT becomes sensible—not as a *matter* distinct, but as a *consequence* on the disturbance of the quiescent state of fixed matter, and becoming intensely sensible from the energy of action exerted in the re-solution of fixed *matter* to its original *elements* which are the *identical elements of light*.

I must apologise to the reader for another quotation from Mr. Gurney's excellent work, to the perusal of which I must again refer.

Mr. Gurney observes, page 307, "I would here ask the question, "Is not *light* a product of *heat*, formed either perfectly or imperfectly as the circumstances which influence the liberation of *heat*, are favorable or unfavorable to its production?"

"Is there not a *certain temperature* which is necessary to its perfect formation?"

"Does not light diminish as the temperature exceeds this standard? and is it not diminished as it falls below it?"

"Reasoning (he continues) from the results of the above experiments and the facts relative to these subjects which are generally known, I cannot (he observes) help concluding *that it is so*—and also that *heat itself* is an *effect* of the peculiar change and condensation of the elements of combustion into new forms and *definite position* of the atoms with respect to each other."—*See Lecture on Crystallization.*

He further observes that "*light, heat, and electricity*, if not modifications of each other, appear to be members of the same family."—*See Gurney's Lectures.*

Now, I consider, that to produce *heat* it is necessary that the elements which constitute *light* must be *ab initio* present, and that it is the energy of their action in approximating each other by the particular individual polarity, by which alone they can combine to form the compound particles of *light*, that the sensation called *heat* producing in all bodies, whether solid, fluid, or gaseous, the needful expansion or rarefaction to *liberate* the elementary *atoms* from their *position* of *conjunction* or *union* of *poles*, appropriate to their then state of *fixation*; and that by such liberation the poles of the elementary atoms are definitely placed, relatively in the most favorable position to present the essential poles to form by immediate conjunction *perfect light*; that the energy of the sensation of *heat* (or *caloric*) is *proportional* to the difficulty of re-solution of the *fixed body* to the necessary degree of attenuation, and final dissolution of such *fixed body* to a *free uncombined state* of its elementary principles; in other words, that each original atom is distinctly separated from its former combination, and ready to unite in the *new compound* of *radiant matter* or *light*.

LIGHT.

THE disputations which have arisen on the subject of *light* in reference to its origin (as advocated by Hooke, Huygens, and Euler), from the system of undulation of a highly rare elastic substance, and the contrary hypothesis of Newton and his (Huygens) followers, as particles emitted from luminous bodies, have continued to perplex philosophers to the present time; some adhering to the one, some to the other, and many sceptical as to the admission of the rectitude of either.

The warmth of discussion created by the antiphlogistic doctrine of Lavoisier and his opponents, Stahl and others, continued for years with an energy proportionate to the obstinacy with which their opposing opinions were maintained.

In a similar manner, geologists contended for the establishment of their respective favorite systems, the Volcanic and Neptunian, with a resolution equally determined.

Now it would appear that the arguments advanced by geologists equally support both systems, and that instead of attempting to establish one distinctly in opposition to the other, it is far more rational to suppose that the *agencies* of *both* have been employed to the furtherance of the existing state of our earth, and that *both* were essentially necessary to its perfection—in-stance the *basaltic stratifications* of the one, and *aquatic depositions* of the other.

In the same manner the disputations of M. Lavoisier, Stahl, &c., may be disposed of through the medium of recent discovery, while with respect to light, the emanating system of Newton, and the undulating doctrine of his opponents, *may be reconciled* by the necessity of the adoption of the agencies of both to perfect and support the continuance of the *radiant matter* of *light*, calculating that the *consumption* of *light* by the absorption of its constituent atoms by combination with fixed matter, is daily

provided for, by *restoration* of an equal quantity of matter from the *fixed* to the *radiant* state, from the emanating points of matter in visible combination, together with that which may combine invisibly through solid, fluid, or gaseous media; in other words, *occult light of electrical generation*.

The *composition* and *decomposition* of matter is solely effected by the principles or elements of *light*, invisibly by the galvanic action, or that continuous course of union which takes place between the *principles* of *light*, and visibly by the combination of bodies, whether solid, fluid, or gaseous, reverting in part from the *fixed* to the *radiant* state.

As the system of transition from one state to the other is continuous, and the reversion equally so, it would appear that when fixed bodies absorb electively *one* constituent, for instance, *oxygen*, the *red ray*, the compensating portions of the *yellow nitrogen* and *blue hydrogen rays* ARE FREE, and at large in the state of *negative electricity*; while on the other hand, when the *hydrogen blue ray* and the *nitrogen yellow ray* are absorbed, and chemically combined with bodies of fixed matter, the *oxygen red ray* is set at liberty to act independently the part of *positive* electricity, and that such alternations of elective absorption and chemical combination, occasion those currents of the opposite electricities pervading the earth, and all bodies of fixed matter, including the surrounding atmosphere.

It would appear that in addition to the compound molecules of light possessing the *three original elements* of constitution, in their usual inert or passive state, when not formed into the radiating lines emanating from a projecting point of combustion, and pervading our globe and its atmosphere, that there are those other separated portions of the constituents of *light*, also filling space both above and below the surface of the earth, awaiting their accumulation to a sufficient extent, to require their junction with the opposite constituents, to form LIGHT or *electricity*, and restore the required equilibrium.

Thus, then, when the surface of the earth is *plus-positive*, and that the superincumbent atmosphere is plus-negative, an electric discharge ensues; but it is almost always observable that the direction of that discharge is to the earth's surface, implying the fact of the repletion of the atmosphere; and that the issue or result of such discharge, is to compensate the abstraction of a certain quantum of the constituents of *light* withdrawn from the radiant state by *chemical* combination with bodies of fixed matter, to perfect the daily operations of nature.

Although the general surface of the illuminated hemisphere of our globe, when the sun is visible to us, is under the *positive* state of electrical influence, yet, in certain localities, under particular circumstances of accidental combinations (equally necessary to perform the demands of nature), an inverted state of the electrical influences as regard the earth's surface and atmosphere, respectively, may exist; yet on most, if not all, occasions, the direction of the electrical discharges is (as before observed) to the earth's surface.

The velocity of light is calculated to be equal to 192,000 miles in a *second*.

The passage of such an imponderable body, however minute, through a space of such *immense length* (permeating an atmosphere *various* in its densities), from the necessary force of projection required for its accomplishment within the given measure of time prescribed, "*one second*," would impress us with the apprehension of a probable error in supposing that *one molecule*, or atom, of the compound matter of light, could traverse such an immense distance without the necessity for the exertion of a projectile force so overpowering, and to which we would conceive it but rational to impute the capability to produce at the point of incidence, on the *orb* of *vision* (for instance), an impression far more sensible than that to which we are (from experience) daily habituated to sustain.

Now it does appear far more reasonable to suppose that it may require a second of time to re-unite in *one continuous line*,

or ray, the several distinct and separate molecules, or atoms of *light*, which were (for the moment previous) standing isolated in every space, or distance, of 192,000 miles which intervenes between the luminous body and the observer; and it may be further added, that the emanation, whether from the *sun's disc* or atmosphere, or from the reflection of light from other of the heavenly bodies, appears to afford the same effect, that is, the *commencement of a pressure sufficient to place the atoms, or molecules of light, within the necessary distance or space of mutual attraction for the completion of the line*, and its continuance, as long as the luminous object is visible, or the line uninterrupted by the interposition of an opaque body.

The theory of the existence of an ethereal substance pervading space, penetrating all material bodies, and occupying the interstices between their molecules, I consider perfectly sustained, and that *light*, or its constituents, in their molecular state, is *that ethereal substance*. That it exists in a position of isolated independence as to its atoms, and that it is subject to the following varieties of action, according to the necessity that may occur for its agency in the progress of nature, or the works of art.

First, That by the absorption by fixed matter, of one or more of its original constituents, it is decomposed. Secondly, That it is separable by the exertion of galvano-electrical influence—one constituent passing to one pole, and the two other constituents proceeding to the other pole; and that the same operation is performed *by Nature*, in the shape of silent electrical discharges, keeping up those constant currents of electricity essential to her works always in active progress.

Thirdly, That in the necessity to supply the deficiency which may have occurred on one side or the other, either of the *magnetic powers*, when *minus*, or *plus*, in quantity, the needful portion of the acquired constituent is immediately afforded, to keep up or restore *equilibrium*, so that the power of effectual GRAVITATION *is never for one MOMENT SUSPENDED*.

Fourthly, That in the constant operations of composition and decomposition, its active agency is ever ready for employment; existing, as it does, as a never-failing fund of matter, reduced, for the purpose of its admirable office, to the *minutest state* (as to its original constituents), that can possibly be conceived to exist.

Fifthly, That when from its treasury a sufficient quantum of its material has become chemically combined with fixed bodies, a further supply to *repletion* is afforded by *emanation* from that luminous body, the centre of our system, or rather *from the effulgent atmosphere of the sun*.

The calculations made as to what may be termed the differential interferences of *light*, have been brought to an extreme degree of precision by Dr. T. Young. They are stated at .00000258th of an inch for the *red ray*, and .00000157th part of an inch for the violet-colored end of the spectrum, while the rays (compound and simple) occupying the intermediate space are of gradations proportional, or nearly, by Newton's prism, as follow:—

Red.	Orange.	Yellow.	Green.	Blue.	Purple.	Violet.
5 to	4½	4	3¾	3½	3¼	3

When two equal rays of *red light* fall on a sheet of white paper in a dark room, they produce a *red spot* of double the intensity of what each of them separately afford; but to effect this, the difference in the length of the two rays from the emanating point to the paper must be .00000258th part of an inch; but the same effect will take place if the difference in the lengths of the two rays are two, three, or four times, &c., the quantity; but if the difference is but one-half the .00000258th part of an inch, or to its 1½, 2½, 3½, &c., part, the one light will extinguish the other, and produce absolute darkness where the red spot had before appeared on the paper; while if the difference be but 1¼, 2¼, 3¼, &c., of .00000258th part of an inch, the red spot produced by the combined beams will only equal one alone.

The difference in the lengths of the *violet light* must equally correspond with the fractional part of an inch, before described as peculiar to that colored ray, that is, the .00000157th; and for the other, the difference must be intermediate in the relative order in which they stand in the spectrum.—See Dr. Thomas Young; Huygens, as the originator of the idea of the Undulatory System of Light; and the admirable observations of Mrs. Somerville.

The phenomena described are considered favorable to Huygens's system of undulation. I freely admit the possibility of the exercise of undulation, but consider that the action of the precise and increased differences in the length of homogeneous rays, and in what are called heterogeneous rays, of perfect light, may be accounted for otherwise. With respect to both, in their extended state, on the spectrum of Newton, as afforded by his triangular prism, they exhibited the striated appearance observed by Wollaston, and described with such precision by Fraunhofer, and amounting to 574 black lines distributed in the 360 parts of the visible spectrum, and 26 outside, which make in the entire 600.

Is there not, probably, some agency exercised by these dark lines to affect, at certain lengths of distance, vibrations capable in one proportional length to be out of the way of interference; at another, to reduce the intensity of the two rays directed to the one point on the paper, to appear not more than can be produced of intensity by *one* of the rays only; and in a *third* case, at another certain distance, to *obstruct* illumination, and *extinguish* light altogether?

May not that total obscurity be produced by the collision of the black lines of each beam or ray, at a certain point of distance of each ray, so as to produce total darkness, in the same manner as the shadows from two candles or lamps when *crossing each other* produce intensity of *dark shade*?

With respect to the cause of the existence of the *dark lines* which intersect the spectrum of refracted light, as produced by

the triangular prism of Newton, it must be recollected that *perfect light*, when proceeding from an emanating point, appears brilliant and white; that when passing through refracting media, it is exhibited in its prismatic COLORED *rays* of composition; and that the order of position and extent of the several colored portions of the spectrum is influenced by the *chemical constitution* of the prism, as well as by its *form*.

We shall for the present reason on the common angular prism of flint glass, producing the *three* original colored rays of *red*, *yellow*, and *blue*, and the other *four* from intermediate superposition.

It must be evident that in the operation of refraction and dispersion, the polarity of the original constituents is sensibly deranged: they assume, instead of the triplicate compound, an individual polarity, or one calculated to transmit a direct line of homogeneous matter of the color exhibited in the given space of the spectrum; and the appearance of the *dark lines* may be occasioned by those atoms which are unable to unite appropriately *pole to pole* in the individual lines, and are therefore *non-luminous*. According to a diagram exhibited by Fraunhofer, the dark lines are numerous in the *red*, and orange, in the *blue* and *violet*, while they are *but few* in the spaces occupied by the *yellow* and *green*.

In the dissolution of *white* or perfect light into the three original prismatic rays, it may occur that a *confusion of polarity* has been produced in some of the rays, which do not undergo *perfect separation* as to their constituent principles, and by this convulsion, instead of retaining the appropriate polarity of *white light* by the union of the positive pole of the one compound molecule, with the *negative* pole of the next compound molecule in succession, which, as appears by No. 6, Plate IV., to be, as to the positive on the surface of that portion of the spherical molecule occupied by the *nitrogen yellow ray*, while its point of union is always with the negative pole in such circumstances ever to be found on the opposite surface, or that

part of the molecule where the *oxygen red ray* is posited, while the *hydrogen blue ray* occupies 1.31 part of the whole sphere, and in its then condensed state is in a *lateral position*, and during the force of pressure, arising from emanation, is (for the time) *dispossessed of all polar influence, whence LIGHT is LUMINOUS*. But, *remove* that pressure of emanation, and immediately the *hydrogen blue ray* expands to its full possession of 8 *parts* in volume of the entire sphere, as described by No. 5, Plate IV. When the *nitrogen yellow ray* in its turn occupies the *lateral position*, and the *positive pole* of the *hydrogen blue* (*always connected with the production of shade*) is the only point of *polarity* to which the *negative pole* of the *oxygen red ray* can possibly be (by attraction) attached, and must consequently, from the *derangement* of the *organised polarity*, produce *shade and darkness* in place of *illumination*.

Hitherto we have confined our attention to the oblong spectrum produced by the Newtonian triangular prism, No. 1, Plate I., we must now observe what becomes of the interference of the *black lines*, by viewing the annular spectrum produced by Field's lenticular prism: this annular spectrum is exhibited No. 2, Plate I.

On viewing a black spot on a white ground, there appears an interior circle of blue, and next in rotation between that and the red, a distinctly defined dark circle, about $\frac{1}{4}$ in breadth of the preceding blue: next follows the red, and externally the yellow, as before observed, occupying with well defined lines of demarkation their respective areas.

Now, it would appear that in this annular exhibition of the three primary rays, the *dark lines* instead of being scattered and diffused, as they are over the extended oblong spectrum, now occupy in the *annular spectrum* a defined and continuous space; and where the refraction is produced from a *dark* central spot on a *white* ground, this circle of shade is evidently visible; while on the contrary, on reference to No. 3, Plate I., where the refraction emanates from a white central spot on a dark

surface, it will be found that a ring of white light occupies the position of the dark circle exhibited in diagram No. 2, the *yellow* having changed place with the blue, and now forming the interior circle, whilst the *red* and *blue* appear in refractive succession to the ring of *white light*.

From this it is evident that there is a connexion between the *blue* and *shade* when in a state of refraction, and that it seems to exercise a power of operation by which the appropriate polarity of a given portion of the compound molecules of light are transmitted, in a state of privation of that luminous appearance which they would otherwise exhibit, if not interfered with by the *hydrogenating influence* of the *blue ray* in its *abstracted capacity*.

It is equally evident that to the *yellow* ray similarly refracted, and occupying the interior circle of the annular spectrum, as described by reference to Diagram No. 3, Plate I., this yellow circle exercises a similar affinity or power of connexion with a band of white light, which accompanies it in the same rotation, and occupying the same area and space, as the black or dark shade is found to do, while accompanying the *blue circle*, as shewn by Diagram No. 2, Plate I. The comparative intensity of the illuminating powers of the several portions of the spectrum are in direct accordance with these phenomena, as the higher illuminating power has always been attributed to the *light orange homogeneous yellow* and *light green*; while the *blue, purple, and violet* are comparatively deficient of such admirable splendor.

It will therefore appear that the interferences of the *blue ray* in its abstracted state of refraction, is calculated to obstruct perfect light by the interposition of shade; while, on the contrary, the *yellow* ray possesses the power of promoting the *effulgence* of light by preserving, by its influence, an adjunct band of *white light*, retained in its regular order of polarity, in other words, in an unrefracted state.

H E A T.

THE theories advanced with respect to the nature of *caloric* aim at the conclusion, that it is a specific matter or body, which by insinuating itself into the interstices between the particles or atoms of solid bodies, is supposed to impart to them an expansive power, by which they appear to be placed at greater relative distances, which if continued with increased temperature, reduces the solid to a liquid, and by a further continuance of action on fluids, converts them into the aëriform or gaseous state.

This contemplates the admission that there exists *a matter of heat*, independently of *a matter of light*, and of that matter which appears in the solid, fluid, and aëriform states; and that the transition of bodies from and to the three last described alternations, is solely imputable to the matter of heat as a direct cause.

Now if *heat* was a distinct matter, we must suppose it to be of a defined quantity, occupying space in all bodies, whether solid, fluid, or gaseous; and should naturally conclude that if it were specific, to be accumulated in one position it must be abstracted from another, which does not appear to be established.

Instead of being a *cause*, I would rather conclude it to be an *effect*, arising from the energies of action exerted by the constituents of *light*, to reunite in the form of *radiant matter* by galvanic or electrical excitement.

Thus, for example, when you take two pieces of dried wood at a low temperature with smooth surfaces, by rubbing them together for some little time, their surfaces become influenced by opposite states of electricity; they inflame, and the combustion is continued until they are in part, or wholly, consumed; during this combustion a portion of *light* is evolved, a portion of the solid matter is converted into the gaseous

state, and the residuum into charcoal, and ashes, (if ignited in atmospheric air,) while the sensation of *heat* is generated as an *effect* only resting on the energy of the process of the transition of fixed matter into the radiant state of *light*.

As all bodies contain *light* in their interstices, subject to the exciting powers of the galvanic or electrical forces, it may be readily conceived that when the contemplated changes of nature or art shall be at any time attempted, a *disturbance* of the corpuscular atoms of *latent light*, by separation to the opposite states of electricity, must, when simultaneously exerted, produce an *expansion* in the solid body, which may then be the seat of action; and that the repetition of those gradual and continuous galvanic or electrical discharges must increase that expansion, till the usual cohesive power by which the atomic arrangements of the body were originally retained are finally overcome, and the body is resolved into its appropriate form, either as a liquid or a gas, or to a radiant state, or one, or more of them, as the nature of the compound is calculated to produce.

Thus, when a stream of electricity is transmitted by a galvanic apparatus, through a piece of small platina wire attached to a copper wire at both ends, of comparatively *large* calibre, the small wire attains, at first, a sensible elevation of temperature, amounting to incandescence, then a white heat, and is ultimately reduced to a state of fusion, while the wire of great calibre which simply acted as a *conductor*, is not in the slightest degree affected, showing that *HEAT* is a *consequence* of the rapidity and energy with which that separated portion, the *oxygen red ray* of *light*, or electricity, had been transmitted through a diminished volume of a metallic body, while the conducting metallic body of thirty or forty, or one hundred times the area, though having received and transmitted the whole of the electrical force alluded to, was not in the slightest degree affected.

Now if *heat* had been a distinct and separate matter or

principle, it should first have accumulated, and have been retained in the conducting metallic wire of greater area, until it had been elevated to an *equal* temperature with the smaller metallic wire which it had fused.

The existence of *light*, radiant and visible in the one instance, and *latent* and *invisible* in the other, while in a state of apparent quiescence pervading all matter generally, in the several forms of which it is susceptible, is (it would appear) quite sufficient to produce *all* the sensible phenomena of *heat*, without the necessity of presupposing the existence of the complex action of a *second* subtile, imponderable, elastic fluid, for the sole purpose of affording that expansion of bodies, by a separation of their constituent atoms, while under the process of reduction from the solid, fluid, or gaseous state, to that of *radiant matter*, when the whole can be so easily effected by *light* itself, by the separation and subsequent union of its constituents, visibly or invisibly, by the forces of electricity, in the proportionable intensity which the circumstances of the re-solution, or combination of the matter then under process of nature, or art, may demand.

Professor Faraday has discovered that many bodies which in the solid state do not conduct electricity, acquire that property when they become fluid, and are then immediately decomposed; and this has induced him to suspect that the power of conduction is simply a *consequence* of decomposition.

The learned Professor further shows, that when a non-metallic *solid* is reduced to a *fluid*, it nearly loses its power of conducting heat, while it acquires that of conducting electricity in a very sensible degree, giving a new proof of the connexion between *heat* and *electricity*.

The general law by which glass and liquids, and other uncrystallized bodies, possess the property of instantaneously transmitting *heat* in proportion to their *power of refraction*, has been established by M. Mellone.

The same learned philosopher found, that the *coloring*

matter of glass diminishes its power of transmitting *heat*, yet that *red, orange, yellow, blue, violet, and white* glass, transmit *calorific* rays of all degrees of refrangibility; but that *green* glass, on the contrary, possesses the peculiar property of transmitting the *least refrangible* calorific rays, and of stopping the most refrangible.

The same elective action is exercised by green colored glass on *heat*, as that of *red* glass on *light*.

The sulphates of alumina and lime produce the opposite effects to those of green glass on *heat*, by transmitting the most refrangible rays with the greatest facility.

It is worthy of observation, that *heat* which has been transmitted through *green* or opaque black glass, will not pass through *alum*, although that which has traversed glass of other colors is transmitted most readily; neither will the *heat* which has passed through alum find its way through *opaque* substances, while abundantly transmitted through *transparent* and colorless bodies: and this would infer that the properties of *heat* emanating from alum nearly approach those of *light* and *solar heat*.

From a review of the various experiments on *heat* by Sir Wm. Herschel, Dr. Wollaston, MM. Ritter, Buckman, and De Laroche; professors Powell and Forbes; Mr. Lloyd, M. Melloni, as well as of those preceding philosophers, MM. Malus, Berard, Leslie, &c.; most of the inferences occurring, they correspond in exhibiting the strong analogy that exists between the properties of *heat* and *light*, and I beg to refer the reader to that exquisite work, Mrs. Somerville's "Connection of the Physical Sciences," which stands unequalled among the contributions of modern writers, as to variety of subjects and the admirable talent and grace with which they are discussed.

Now from the prolongation, the radiation, reflection, and other properties of *heat*, exactly consonant to those exercised by *light*—from the power of some media, solid and fluid, to produce a change in the nature of *heat*, as to its easy or difficult

transmission through other bodies subsequently, it would appear to partake so immediately of the nature and properties of *light*, as that I should impute to them a direct identity; and that as *light* pervades all bodies, and that in its separation from fixed bodies in which it was temporally retained, and while approximating the state of visible radiancy or perfection, it may assume an intermediate state of an invisible nature, affording the *sensation* and qualities of *heat*, without any other cause than the energy of action to effect its transition, and not in the least supporting the idea that *heat is a body distinct from light*; and further, that the separations that have been effected of the calorific invisible rays from the colorific visible rays can only be considered as a divisional state, produced between *perfect light* and the residuary uncombined constituents of *light*, when approximating union to produce that splendour which CELESTIAL *light*, in its complete effulgence, so manifestly exhibits.

It has been observed by sir John Herschel, that the heating power of the solar rays gives a *primâ facie* plausibility to the idea of a *transformation* of *light* into *heat* by *absorption*, but that it is incumbered with difficulties, as the most *luminous* rays are not the most *calorific*; while, on the contrary, the calorific energy is of greatest intensity in the *feebly illuminating* rays.

He also observes, that although without explanation at present, we may yet have it in a more advanced state of knowledge. "*What becomes of light?*" A perplexing question to the corpuscular philosophers! while he says the answer afforded by the undulatory theory is simple and distinct; that it merges on the more general question,—*What becomes of motion?* And the answer, he repeats, on dynamical principles, is, "*that it continues for ever.*"

Now the circumstance of the greater portion of *calorific intensity* being afforded by the *less luminous* rays, is in accordance with the theory that I beg to advance, that HEAT is but a *modification* of *light*, from the absence or abstraction of some one or more of its original principles of composition,

effected by *absorption* or *combustion*, wherein the *oxygen red ray*, for instance, combines with the *body* submitted to its action, and the *hydrogen blue ray* is PLUS, at liberty to produce, by means of its vibrations in conjunction with the *nitrogen yellow ray*, (or solely, as the case may be,) certain *disturbances* of the equilibrium while seeking a reunion with the necessary and appropriate atoms of *oxygen* to re-constitute LIGHT; and by its excessive energy in its operation affords the *sensation* called *heat*, and which is in a ratio of thermometrical intensity, corresponding with such energy of action as may be required to reduce the compound matter under process to its original constituents, whereby such portion of them as may be essential to the reformation of *light*, shall have been separated, and in a position to assume the order of polarity, requisite for the *completion* of the *radiant state* of *light*.

VOLTAIC ELECTRICITY.

SINCE the origin of the science of voltaic electricity, by the early experiments of Volta, followed by the further elucidations of Galvani, the subject has been pursued with unabated ardour by the philosophers of the Continent, as well as by those whose talents we can claim as the particular property of our country.

But before we make reference to those splendid discoveries of recent date, which have proved the now universally acknowledged *identity* of *electricity*, the *galvanic influence*, and *magnetic power*, or touch upon the distinguished persons to whom the honour of those brilliant discoveries are eminently due, we shall consider some of the inferences which may be drawn from the phenomena attributable to the action of the Voltaic battery, in reference to *composition* and *decomposition*.

It appears from experiment that when a disc of bright zinc is immersed in an open jar of pure distilled water, even there

without the interference of an acid, or the introduction of copper or iron, or any other metal which may be in a distinctly opposite state of electricity, the zinc when in contact with the water, having its lower and upper surfaces in opposite states of electricity, its action in the decomposition of the water commences, the *oxygen* being attracted to the positive poles of the metallic surface; by continual interchange elementary electrical currents are produced, and pervade the metallic and fluid media, in a direction exactly conformable with that produced by a pair of plates of the Voltaic pile.

The power of composition and decomposition are naturally increased by the introduction of a few drops of acid, affording thereby a diversity of polar action, and greater intensity than can naturally be produced by a fluid composed of only two elementary constituents.

In operations where dilute acidulous menstrua are employed the polar energies are employed in a moderate ratio, and may be exalted to considerable force by a further increase of acidity, but by the introduction of a piece of copper wire placed in direct contact with the disc of zinc, the energy of metallic corrosion is considerably increased by the metallic combination with *oxygen*, while the *hydrogen* of the water is discharged in the gaseous state in great quantity.

Two peculiarities are observable in reference to the electrical state of metallic surfaces, when one metal alone is used, (say zinc, or iron, in a dilute mixture of distilled water and sulphuric acid,) that is, that fountains of liberated hydrogen are discharged from certain points only from the upper surface of the metal, while the intervening spaces appear to be in a dormant or inactive state, and further on introduction and presentation of a wire of another metal (say copper) to within a certain distance of one of those fountains of gas, the discharge from the fountain becomes more feeble, and on its nearer approach totally ceases, the discharge being then usurped by the metallic wire, as observed by Mr. Sturgeon, in his "Annals of Chemistry,

Magnetism, and Electricity ;" to which excellent work the reader is referred for these and a variety of other interesting phenomena.

In the powerfully-energetic action consequent on the introduction and direct contact of two distinct metals in acidulous media, and the quiescent state to which these operations are reduced by the sudden separation of contact of such metals, would rather support the theory that the polar arrangements, as to their molicular combination, are various and distinct in *every species of metal* ; and that such difference of constitution, influencing their *crystalline* form, indicates their *compound nature*.

The precipitation of metals from their acid solutions by the introduction of some other metal, such as copper by iron, lead by zinc, as in the instance of the lead or philosophical tree, and silver by mercury, as in the case of the arbor Dianæ, exhibiting as they do most beautiful arborescent formations, are instances of the electro-galvanic action; and the assumption of such forms are perfectly analogous with the operation of the same force in the *formation of organized* bodies in the vegetable kingdom.

In the elaborate researches of Professor Faraday, conducted with his usual accuracy and precision, on the interesting subject of electro-chemical decomposition, he has drawn inferences from a number of experimental results, by which he has established from a series of facts some laws of electro-chemical action of *high importance*.

It may be as well to remark that the learned Professor has adopted terms at once appropriate and expressive of their nature, and derived from the Greek. For the term pole he uses that of electrode as a substitute; and to convey the idea of the point at which the current of electricity is considered to *enter* the decomposing body, as parallel to that supposed to exist in the earth, he calls the negative extremity the anode, where oxygen, chlorides, acids, &c. are evolved, and is against or opposite the positive electrode; while he uses the word cathode to express that surface at which the current leaves the decomposing body,

being its positive extremity, at which combustible bodies, metals, alkalies, and bases are evolved, and is in contact with the negative electrode.

He declares as a result of his experiments, that water, though a compound, formed of very powerful affinity, is most susceptible of electrolytic action, and yields up its elements under the influence of a very *feeble* electrical current.

All known compounds being non-conductors when *solid*, but *conductors* when *liquid*, are decomposed with the single exception of periodide of mercury, and even water itself, which so easily yields up its elements when the current passes, if rendered *quite pure* scarcely suffers change, because it then becomes a bad conductor, which argues the possibility that decomposition depends upon conduction, and not the latter upon the former; a point which water seems nearly to decide.

Although the mineral acids facilitate the *conduction* and *decomposition* of water, that is no proof that they are competent to favor and suffer these actions in themselves.

Boracic acid effects the same thing, though not decomposable.

M. De La Rive has pointed out that *chlorine* has this power: though considered by us hitherto *an elementary substance*, it ought to be capable of suffering decomposition or imparting it to other bodies.

Professor Faraday observes, in reference to one standard of measurement of the common and Voltaic electricity, that the chemical decomposing action of a current of *either* is constant for a constant quantity of electricity, notwithstanding the greatest variations in its sources, in its intensity, in the size of the electrodes used, in the nature of the conductors, or non-conductors, through which it is passed, or in other circumstances.

That exactly the same quantity of water was decomposed in all the solutions by the same quantity of electricity, though the sulphuric acid in *some* solutions was *seventy-fold*, what it was in *others*. The highest strength used was of specific gravity 1.495, but that solutions of a gravity of 1.336 were the most

uniform in results, and the *oxygen* and *hydrogen* more equable in proportion to each other.

If the acid were very strong a remarkable disappearance of oxygen took place: thus a solution of two measures of strong oil of vitriol with one of water gave 42 volume of hydrogen, with but 12 of oxygen, which favored the formation of oxy-water, which M. Theynard has shown to be occasioned by the presence of acid.

When solutions of potassa, or soda, or sulphate of magnesia, or sulphate of soda, were acted upon by the electric current, just as much oxygen and hydrogen were evolved from them as from the dilute sulphuric acid with which they were compared. When a solution of *ammonia*, rendered a better conductor by *sulphate of ammonia*, or a solution of subcarbonate of potassa, was experimented with, the hydrogen evolved was in the same quantity as that set free from the diluted sulphuric acid, with which they were compared. Hence changes in the nature of the solutions do not alter the *constancy* of the *electrolytic action* upon *water*.

The learned Professor concludes that the investigation he has made sufficiently establishes the extraordinary principle, with respect to water, that when subjected to the influence of the electric current, a quantity of it is decomposed, exactly proportionate to the quantity of electricity which has passed, notwithstanding the thousand variations in the conditions and circumstances under which at the time it may be placed.

The learned Professor in another part remarks, that he considers it established by an irresistible mass of evidence, that the chemical power of a current of electricity is in direct proportion to the absolute quantity of electricity which passes.

The inferences to be drawn from the great variety of experiments described by Professor Faraday, in his interesting researches on this subject, are—That in the bodies submitted to electro-chemical decomposition, where they contain in their composition *oxygen* and *hydrogen*, as water, or acidulated solutions,

metallic or otherwise, that the *positive* is determined to the positive electrode, or anode, while the hydrogen is invariably evolved at the negative electrode or cathode, as primary results; that when secondary results occur, and that *nitrogen* is found to appear at either of the electrodes, in conjunction with oxygen at the one, or with alkalis at the other, it appears to be governed by attractive influences to which it submits. But in the case of *ammonia* (rendered a better conductor by the addition of sulphate of ammonia), while *hydrogen* is evolved at the negative electrode, nitrogen is determined at the positive electrode; and further, that in all cases of decomposition *hydrogen* is evolved definitely from the negative electrode, and evidenced either in its discharge in a pure state, or contributing to the reformation of metals determined to the same electrode, and is to be found in their composition when their *oxides* have been submitted to experiment by electro-chemical action.

The *red ray* (or *oxygen*) is therefore determined to one electrode, while the *blue ray* (*hydrogen*) is evolved from the other, and the *yellow ray* (*nitrogen*), whose proper electrode is the same as the blue (*hydrogen*) ray, is, on occasions, for instance, where a chloride of calcium or soda is under investigation, the *chlorine* flies to the *positive*, and the *base* to the *negative* electrode.

Chlorine is, from its appearance, color, and properties, a compound of nitrogen in maximum, hydrogen in minor proportions, and (perhaps) oxygen in minimum,—and the basis of *all* the *alkalies* is *nitrogen*, and they are consequently determined to the *negative electrode*; while the *metals*, holding in their reduced state *hydrogen in excess*, proceed to the *same electrode*, and oxygen separated from oxides, acids, and water, or aqueous or acid solutions, go to the *positive electrode*. And where any deviation occurs, as in secondary results, it will be found that any partial quantities of *hydrogen* and *nitrogen* found to issue from the *positive* pole, must be in a *compound state*, or in conjunction with *oxygen* or *compounds* containing it.

ELECTRICITY.

WITHOUT further reference to the contentions that have existed on the subject of the systems of electricity, I shall premise, that I consider that electricity is exhibited by the application of means through the medium of friction, to produce a separation of the original elements which are combined in the *compound molecules of light*. That in producing the decomposition of *light*, whether by those means of friction, by the common electrical machine, or through the exercise of the *Voltaic* apparatus, the same separation is effected. What is called the positive electricity in the one case, coming to the one pole, whilst the negative proceeds to the other; the difference being simply, that in the *galvanic* arrangement the supply of the electricities is continuous and compensating, while with the common electrical machine either of the electricities, positive or negative, can be collected in a battery or jar, in a state of *aggregation* for a given period, and that the separated and compensating portion, from which the collected quantity has been abstracted, *is evidently contiguous* and ready to be united by the effect of a discharging rod, or any convenient conductor applied for such purpose.

When two bodies in opposite states of electricity are presented to each other, at a distance commensurate with the forces of attraction exercised by both, they come in contact and continue so for a short period, when they are found mutually to repel each other.

These phenomena may be accounted for thus:—That (we will say,) two balls suspended, and by being electrified, possessing the *separated* constituents of *light*, on approaching each other, those constituents exercise an attractive power, sufficient to cause them to reunite and form *light*, which then becomes occult, and *pervading the balls to repletion*, afford to them the

same power of *repulsion* as these *new-formed molecules of light* can exercise towards each other, from the angular position of their poles, as long as they remain in an *insulated* state, as exhibited by the Diagram No. 5, Plate IV.

The decomposition of light effected naturally by the chemical operations in continued action throughout our globe, produces accumulated quantities of either species of electricity, in certain localities where the *opposite* species has been electively and chemically combined with fixed matter, in either *organic* or *inorganic* bodies.

The alternations that occur by the abstraction of some or one of these elements from the compound molecules of *light*, effect *redundancies* and *deficiencies of quantities* in localities of certain extension, governed by the amount of *consumption* of the *abstracted elements*, and these continuous alternations produce the detached and isolated aggregations of electricity of the *opposite species*, which is never far distant, and is to be found either in the adjacent atmosphere, when the reunion is exhibited under the phenomena of *lightning*; or should that not be the case, through the medium of conduction in the body of the earth.

These interferences, of a *minor description*, have no effect in deranging the *electrical envelopes of the opposite surfaces of the earth*, being proportional as they are in force to the magnitude of the area of the earth, acting as they do in respect to their polarity, as the minutest particle or atom is affected by its proportionate quantum.

By the motion of a triangle round one of its sides as an axis is formed, as it were, a circular prism, which from its uniting the properties and figure of a lens with that of the prism, may be called a *lenticular prism*, or double convex prismatic lens, of which the following presents an outline.—See Plate II., Fig. 1.

By a like circular motion of a triangle upon that angle, which corresponds to the angle of refraction in a prism, will be

generated a similar double concave lenticular prism, opposed to the above, as represented in the next figure.—Plate II., Fig. 2.

The above figures are sufficient for the present purpose ; yet it is evident that they are *extremes* between which lie an indefinite series of intermediate figures, and that there are innumerable others, both conical and annular, generable upon the boundless variety of figure and motion.

To apply the prism thus varied to the purposes of experimental philosophy, an instrument has been contrived by Mr. Field, of which the following is a brief description, and which, from its power of exhibiting colors, he has denominated the *chromascope*.

This instrument in its general form consists either of a tripod, or of a base or stand, having two arms or props which support the axis of a tube five inches long, at the lower end of which is the lenticular prism above described (Fig 1). The principal tube slides from end to end, through a short tube attached to the axis, and has at top a narrow sliding tube of three inches fitted with a lens or eye-glass of eight inches focus.—See Plate II., Fig. 3.

By this construction the tubes may be elevated or depressed above the stand, and at the same time turned and fixed at any required angle of the horizon.

Such are the instrument and its parts ; the design of which will be rendered apparent in its application to the following experiments.

Experiment 1st.—In the centre of a piece of white paper six inches square form a black spot, place it upon the stand of the chromascope, opposite to the light of a window, and adjust the instrument in its vertical position, so that the spot may be close to and concentrical with the lenticular prism—then gradually sliding the tube upward, looking at the same time through it, the spot will appear to expand and be refracted into a beautiful annular-colored spectrum or aureola.

If now the double concave lenticular prism (Fig. 2) be inter-

posed between the chromascope and the spot, the aureola will be by a counter refraction reduced to a spot at its centre.

Remarks.—It would be difficult to account satisfactorily for the production of colors in the above experiment, by the analysis of light alone, since the colored spectrum would vanish if the black spot were removed. It is to be presumed, therefore, that the principle of shade in the spot concurs with the principle of *light* in the ground in producing the colored iris.

Experiment 2nd.—If the preceding experiment be performed with a white spot upon a black ground, in place of the black spot upon the white ground, a similar spectrum will be produced in which the colors will be inverted.

It is not necessary that the objects and grounds opposed be black and white to produce a spectrum; it is sufficient that they be *lighter* and *darker* with reference to each other; nor is it necessary that they be not colored, since a blue, red, and yellow spot upon a ground lighter or darker than itself yields a colored spectrum similar to the above, in which, notwithstanding the particular color of the spot itself predominates, each of the primary colors distinctly appears.

Fig. V., Plate 2, represents part of the instrument invented and described by Mr. Field, and called a chromometer, in which A B C D is a hollow prism or wedge, in each side of which is cemented and secured by a brass frame and screws, a colorless plate of glass, *e f g h*, which glasses touch each other within at the end, *e g*, and diverge or separate at the other ends to the thickness of the wedge at *f h*. We thus obtain a hollow prism pervious to the light and vision, which might be filled with a transparent colored liquid by means of an opening and screw stopper in the end B D. To prevent compression of the liquid the stopper should be perforated lengthwise, that the air may escape and the perforation be secured by the screw or plug E.

It is evident this wedge being so charged with a colored liquid, and viewed opposite the light, will throughout its broad

face present a perfect gradation of color from the utmost diluteness or minimum, at the convergent extreme, *g e*, where the glasses touch, to the utmost depth or maximum, at the divergent extreme *f h*, where they are at their utmost separation.

On one side of the wedge *C D* is screwed a brass scale of the exact length of the cavity within the glasses *e f g h*, geometrically divided into 32 degrees, each subdivided into 4 others, forming evidently an accurate measure of thickness increasing at each division from the point of contact of the glasses, and are consequently also a true numerical measure of the intensities of transparent color without the wedge. Such a prism, charged with a *blue* liquid, will form a cyanometer, or measure of *blue*; with a *red* liquid, an *eruthrometer*, or measure of *red*; and with a *yellow* liquid, a *xanthometer*, or measure of *yellow*, the colors of such liquids being adjusted to a given intensity.*

By the application of the *convex* lenticular prism, Mr. Field has effected, 1st, the refraction of a beam of perfect white light into the three primary colored rays of red, yellow, and blue, perfectly distinct, and forming a circular iris without the appearance or intervention of any of the heterogeneous or compound rays which are usually occasioned by the obliquity and superposition of the rays exhibited in the imperfect spectrum produced by the Newtonian or common triangular prism.

2ndly. That these original colored rays, the red, yellow, and blue, are immediately restored to reunion, and form *pure white light* by the simple intervention of the double concave lenticular prism, Fig. 2, Plate II., by which the identity of these three colors in the formation of light is doubly proved; first, by *analysis*, and ultimately by *synthesis*.

* This description of the instruments invented and applied by Mr. Geo. Field is taken from his "Æsthetics, or The Analogy of the Sensible Sciences," and also from his "Chromatography, or Treatise on Colours and Pigments," (published by Tilt, Fleet Street,) to which for other most interesting and valuable information the reader is referred.

3rdly. By the application of the *convex* lenticular prism and chromascope to the black spot on the white ground, the *same three original coloured rays* are rendered distinctly evident and homogeneous, showing that the prism has the power to decompose the light which has been exhibited in the form of *shade*, and that the same *identical* coloured rays are, by transverse interposition, rendered anti-radiants, and consequently incapable of reflection. But the action of the *concave* prism immediately restores the rays so refracted to the original state of shade or black spots; and that the same effects are produced by the alternate application of the convex and concave prisms respectively, on the *white spot*, on a *black* or *dark* ground. It therefore appears fully established by the experiments of Mr. Field, and by those of Sir David Brewster, that there are but three original coloured rays in the composition of light, as exhibited by the solar beam.

The black lines which striate the spectrum produced by the common triangular prism, as described by Wollaston and Fraunhoffer, are not to be found in their confused state in the annular iris produced by the prism of Field, but are visible in *one continuous circle* always adjoining the *blue*, without interference or intersection of any other coloured ray in the aureola.

The *three* original coloured rays can therefore appear separate, distinct, and homogeneous—and can form conjointly white radiant and reflected light, or dark shade, capable of *refraction*, but not of *reflection*.

The analogy is worthy of notice, that oxygen, nitrogen, and hydrogen are distinct and homogeneous; that they form (as here presumed) *carbon*, which is *black* and incapable of *reflection*, but in its crystallized state, the *diamond*, is translucent, and possesses the power of *refraction* and *reflection*.

To adjudicate the proportionate quantum of space actually occupied by *each* coloured ray in the formation of a given area of light, Mr. Field adopted his very ingenious instrument, already described, and exhibited in the several Figures, 5, 6, 7,

8, and 9, Plate III., which he denominates the *chromometer*, or *colour-gauge*. By adjusting the graduated wedges (filled as to their transparent compartments with coloured liquids, of red, yellow, and blue tints, perfectly conformable in density with the coloured prismatic rays), he was enabled, by looking through the eye-hole, to ascertain the precise quantity of each coloured liquid necessary to produce *perfect white transparent light*, and which on examination of the tabulated wedges he found to be = 5 parts red, 3 parts yellow, and 8 parts blue; which, by experiments on his instruments, with which he kindly accommodated me, I have confirmed by similar results.

It would appear that the power of *heating* is *greater* in the *invisible rays* outside the spectrum of the triangular prism, and next to the *red ray*, and that in their ratio of intensity they may be 70, lamp-black being 100. Sir H. Davy states those invisible rays are capable of *reflection* as well as *refraction*, like the other rays.

The radiation of terrestrial matter producing *heat* was made known by Del Cemento, Hooke, Scheele, and Pictet. The opinion of Mr. Leslie, that the phenomena of the radiation of *terrestrial heat* depends on *certain pulsations or undulations of the atmosphere* capable of being *reflected*, but not of being *refracted*, is stated to have been contradicted by the result of the experiments on *platina wire*, by *heat* excited by a Voltaic battery in a receiver exhausted to $\frac{1}{120}$, by which it was found a thermometer rose nearly *three times* as much as when it was in its *natural state of condensation*.—See Sir H. Davy, Elements of Philosophy, page 207.

This appeared to be governed by the effect of *pressure*, the cooling power of the rarefied air; that is, its absorption of caloric being much less in its rarefied than in its natural state.

The colored bodies that *absorb most light*, and, of course, reflect *least*, are the most heated when exposed to solar or terrestrial rays—1st black, 2nd red, 3rd green, 4th yellow, last, white.

The radiating power of the body heated is in the same ratio with its absorbing power. *Charcoal* has the *highest radiating power of any known substance*, and may, therefore, contain *oxygen*, *azote*, and *hydrogen*. According to Mr. Leslie's ingenious researches, taking the radiating power of lamp-black at 100, the following radiate in the proportions thus expressed:—sealing-wax 95, crown glass 90, China ink 88, ice 85, minium 80, isinglass 80, plumbago 75, tarnished lead 45, clean lead 19, polished iron 15, tin-plate, gold, silver, and copper 12.

Of the influence of *radiant* matter in producing *chemical* changes, we have an instance exemplified by MM. Gay Lussac and Theynard, and Mr. Dalton. When a mixture of *chlorine* and *hydrogen* is exposed to the solar beams, they *detonate*, though the same effect is not produced by the application of a heat below ignition. Sir H. Davy, in explanation, says, he supposes the temperature of particles of substances is raised considerably and instantaneously by the *rays*; but it may be likewise, and with more probability, be supposed to depend upon a specific and peculiar influence of *radiant matter*: and that such an influence exists, is proved by many circumstances.

When moist horn-silver is exposed to the influence of the violet ray, and those invisible rays beyond it, it is blackened, and muriatic acid gas is formed, as proved by Messrs. Ritter, Wollaston, and Berthollet, so that they may be termed the *hydrogenating rays*.

The general facts of refraction and effects of the *solar beam* offer analogy to the agency of *electricity*. In the Voltaic circuit the *maximum* of *heat* seems to be at the *positive* pole, where the power of combining with *oxygen* is given to bodies, and the agency of rendering bodies inflammable is excited at the opposite surface; and similar effects are produced by *negative electricity*, and by the most *refrangible* rays of the solar beam.—See Davy's Elements of Chemical Philosophy, p. 212.

It has been remarked that the health of vegetation, with the color of plants and flowers, depend on the presence of *light*;

and even animals, also, in the color of their hair, are influenced by the same power, as may be proved by comparing the *polar* and *tropical* animals, and the parts of their bodies exposed to, and excluded from, *its presence*.

The discoveries of Newton respecting the modifications of light by double reflection and refraction, have, for a time, set aside the hypothesis supported by Hooke, Huygens, and Euler, as to the supposed existence of a rare elastic substance, which, by *undulation*, produced the sensations of vision. As the colored rays separated by the prism bear the same relation to double refraction that direct light bears, it follows that the polarity of the different particles must be of the same kind, as mentioned by Sir H. Davy; who also remarks, that Newton attempted to explain the different refrangibilities of the rays of light by supposing them to be composed of *particles differing in size*; and he states that this hypothesis is not contradictory to the idea of their being regular solids endowed with similar polarities. The same great man (Newton) *put the query*, Whether light and common matter are not convertible into each other? and, adopting the idea that the phenomena of sensible heat depend upon vibrations of the particles of bodies, supposed that a certain intensity of vibrations may send off particles into free space; and that particles in rapid motion in right lines, in losing *their own motion*, may communicate a *vibratory* motion to the particles of *terrestrial bodies*.

The rays of light materially differ in their refrangibility, calorific power, and intensity of illumination.

The red ray is the *most reflexible* and *least refrangible*. The blue and violet rays the least reflexible and most refrangible; the others in the order in which they stand in the spectrum. When light passes within a certain distance of a body parallel to which it is moving, it is bent towards that body; this property is termed *inflection*; when it passes at a greater distance it is bent from it, which is called *deflection*. Now

the order in which the rays stand, corresponds with that of their inflexibility and deflexibility, the red possessing the most, and the violet the least.

This was suspected by David Rittenbourg, but first demonstrated by the ingenious experiments of Mr. Brougham. Light, when passing obliquely from one medium to that of another of greater density, assumes a direction different from its original line, it is then said to be refracted, and bends *towards* the perpendicular; and if that medium is a combustible body, the refraction is proportionally greater, as its attraction for light is greater than that of an incombustible.

The refracting power of *water* induced *Newton*, who was acquainted with this law, to suspect that it contained something of an *inflammatory description* in its composition, which the subsequent analysis of water has fully authenticated.

The red ray communicates to bodies the most powerful degree of *heat* within the spectrum; but it has been discovered that there are *invisible* rays just without the red ray, which exceed it in calorific powers, as stated by Dr. Wollaston and Sir John Herschel.

“The greatest illuminating powers are in nearly the centre of the spectrum, the lightest green and deepest yellow.”—HERSCHEL.

Is this occasioned by the difference or excess of density, or comparative specific gravity of the rays original and combined, which occupy that portion?

It is not within our reach to ascertain in their highly rarefied state, the proportional specific gravities of the rays of light; they have therefore hitherto been deemed, and are called, *imponderable*; but this arises from the insufficiency of our means to designate the weight of what requires the most minute and delicate application, and to such as we never can in reason aspire. But as light is admitted to be a *substance*, occupying space, subservient to the laws of attraction, and the

effects of pressure, may we not conclude that it possesses *actual weight*, although from its incalculable levity it may, to some, appear the reverse at present? We may therefore, from *analogy*, presume to affix to the rays of light a ratio correspondent to that of the particular *original elementary matter* of which *it is here submitted* they are composed, to enable us to judge whether the vigour of their respective action may not be, in some degree, influenced thereby; and whether such may controvert or support the present hypothesis.

The intensity of the illuminating power of light seems to depend on the energy of *repulsive force*, which is governed by *pressure*, the effect of which is proportional to *gravity*. Now the comparative space occupied by the original rays in the spectrum, obtained by the triangular prism, is as follows:

Red, 58.5.

Yellow, 91.5.

Blue, 210.

These multiplied by the respective specific gravities of each of the bodies they severally represent, give the proportionate intensity of their illuminating powers, thus:

Red, 9.360.

Yellow, 12.810.

Blue, 2.10.

On the nature of light, two different theories have been proposed: the first by Huygens, adopted by Euler, "That light is a subtile fluid, filling space and rendering bodies visible by the undulation into which it is thrown; that when the sun rises it agitates this fluid; these agitations gradually extend themselves; at last, striking the eye, we see the sun."

The second by Newton, and others, "That light is a substance consisting of small particles constantly separating themselves from luminous bodies, moving in straight lines, and rendering bodies luminous by passing from them and entering the eye."

It is presumed it can be shown that *both* of these theories are in part reconcilable by the present hypothesis.

It is not by any means evident, that the system of *undulation* can be supported as one capable of *independently* effecting the production of *light*, in *straight lines*, and with that remarkable *impetus* which light so eminently displays, and which *undulatory motion alone* cannot be in reason supposed to *impart*.

It is equally improbable that the system of *emanation* can be sustained, without the aid of *some necessary auxiliary*, upon the principle, that if emanation was *continuous*, from a *luminous body* in a given period, *exhaustion* must consequently ensue, which would not appear consistent with the present order of the universe.

But we can readily comprehend, that *both systems*, by their united powers, can effect the production and transmission of celestial light, and act conformably with the laws by which it appears to be governed.

Thus, the undulatory system may convey the idea, that the compound spherical atoms of light continue to *pervade* our atmosphere, and the entire intervening space between our earth and the sun, and all the other heavenly bodies; that these atoms are in their *free* and *expanded* state REPULSIVE of each other, from the angular position of the poles of their *individual* molecules, exhibited on the surface of the compound atom of *light*, see No. 5, Plate IV.; that they require a *pressure* to bring them into a uniform state of *condensation*, and also within the *precincts of attraction*, to be exercised on the *proper poles* (the *positive* and *negative*) of the compound spherical atoms, so that they may form a *line of radiation*; and that such condition is only to be effected by the *projectile force* of the compound atoms of light *emanating* from a radiating point of a luminous body, such as the *sun*, or the *resplendent atmosphere* with which that body is surrounded, and which may be replenished from the *free light in space* so as to *prevent exhaustion**.—

* Query.—May not the supply of *FREE light*, to replenish the atmosphere of the sun be *continuous*, flowing in directly opposite lines, and intermediate to

And as it is clear, that under all circumstances, such as have been described, as well from reflecting surfaces as from terrestrial bodies by combustion, producing light, the system of *emanation* is *decidedly requisite* to perfect the production of *radiant light*; and further, that the *united forces* described under the laws of *undulation* and *emanation* appear essential to explain the *imputed velocity of light* in its passage through space (as before observed), by substituting the *period* required for the union of the spherical compound atoms of light, for the less rational conception that *one single atom of light could by any projected force be carried through atmospheres of great and various densities, at the enormous rate of 192,000 miles in a second.*

The foundation of the undulatory system may rest on the appearances afforded by the *contraction* of the compound spherical atom of light, from the expanded state in which it is exhibited, in No. 5, Plate IV., and which *contraction*, although described to be occasioned by the needful condensation of the molecules of *hydrogen* and *nitrogen* to the *highest density*, that of the *oxygen* molecule, by which, on calculation, the area is reduced, say from 400 to 212.5, or nearly one *half*—although that *reduction* has been by accident omitted to be comparatively depicted *as it should have been* in the diagram, No. 6, Plate IV.: yet it is requested that the circumstance may be carried in recollection, in the future consideration of the condition of condensation to which the compound atoms of light are reduced, when brought by the *pressure* of *emanation* to the state of *linear rays*.

those of the rays of celestial light projected from that *effulgent atmosphere*; and may not such circumstance have an influence in producing the *black lines* of shade which *striae* the spectrum of the triangular prism, and form a ring, accompanying the *blue* ray, as exhibited by the convex lenticular prism of Field?

REPULSION OF LIGHT PROMOTES TRANSITION TO FIXITY.

IN addition to the properties of vision and velocity alluded to, of which all other bodies are destitute, *light* possesses another which constitutes its grand characteristic as radiant matter. That its particles or atoms appear possessed of *repulsive force*, and are therefore never found forming masses of any sensible magnitude, as observed by Dr. Thompson.

On this law its capability of transition to a fixed state seems founded.

It would appear that from the moment matter assumes the *radiant form* there is a complete termination of the contact of its particles, except by *direct force* arising from *pressure*, the result of a propelling power equal to overcome the existing repulsion they exercise towards each other; where the influence of this propelling power ceases, light is no longer *visible*. Its combination with fixed bodies is, however, the more easily effected, being promoted by the disposition they evince with respect to aggregation so foreign from that of the atoms of radiant matter to those of their own nature; and this circumstance may be the effect of an opposite arrangement, with respect to *polarity*, as hereafter explained.

The polarization of light was discovered by Malus. Much has been added of new facts on this subject, by Messrs. Bigot and Arago, and by Sir David Brewster.

The colors which bodies of fixed matter exhibit when viewed, is occasioned by their power of absorbing all the rays save that one, or those two, or more, that form the color reflected, from the bodies' surface.

This is a fact admitted, but it has not hitherto been accounted for. It is, however, a part of this hypothesis to show, that it arises from *repletion* in the visible surfaces of the atoms; in other words, that the matter of the ray or rays *reflected*, exists

in *excess* in the *presented surface* of the *fixed body* ; and when light falls on it, all the other rays are absorbed.

The evidences in support of the position will be adduced in their proper place.

The absence of caloric, in the instance of *reflected light*, may account for the latter's being incapable of *refrangibility*.

The energy with which caloric is communicated, is increased by pressure, producing closer contact.

The intensity of *light* produced by the combustion of fixed bodies, is proportional to the elevation of temperature acquired, which is influenced by the energies with which the material rays enter into combination ; and this is *variable*, according to the particular circumstances under which they are presented.

When chemical combinations are formed by bodies in a fixed state, *heat* is *evolved* or *absorbed* ; but generally no *change* to that of the *radiant state* is effected without *combustion*.

But when from the mutual action of bodies combustion arises, there is an *absolute transition* of a certain portion of fixed matter to the radiant state, and the residuum is fixed matter, the qualities of which are generally quite different from those it possessed in its previous form ; that difference arising either from the acquisition of the matter of some ray or rays, of which it was deficient, or the abstraction of others with which it may have been originally replete.

Heat and *light* both exist in the atmosphere ; the *former*, but a *modification of the latter*, is the active agent of combination between the light in its perfect state, and fixed, or inert matter.

Light is evident to us when it emanates direct from a point of radiation, and continues visible during the existence of that point as a centre of action, and therefore appears to be governed by the effects of *pressure*.

But the production of light does not rest on its separation as a *specific body* from oxygen, or the atmosphere, by the act of combustion, as it was supposed by M. Lavoisier, who also

considered that *oxygen*, after having submitted to combustion, having parted with the *light* with which it was supposed to be combined, was no longer capable of affording *light*: this is completely contradicted by the following experiment.

Place in Dr. Ure's eudiometer a minute quantity of each of the following gases, having previously submitted them *separately* to the electric spark, viz., oxygen, carbonic-oxide, azote, and hydrogen, they will, in their dephlogisticated state (as it is termed), produce *light* by the agencies of electricity; proving thereby that it was not previously combined with any of them as a specific body, but that *they each contribute to its direct formation*, and exhibit the *transition of matter to a radiant state*. It is not here asserted that the *entire* of these gases will be *at once* converted without leaving a *residuum* of fixed matter, but it is affirmed that the nearer they are proportioned to their relative quantities, the less will be the residual gases or product unconverted. The quantity operated upon being so small, difficulties arise in affording exactitude of proportion, which is also in itself to be yet more perfectly attained by a series of experiments, which require the greatest precision.

Happily, the durability of fixed matter throughout nature is secured by the difficulty of producing, on an extensive scale, the matter of the three essential rays under the requisite circumstances of proportion and position, to constitute their immediate conversion to the radiant state. Were it otherwise, it would overturn the beautiful arrangement which exists according to the order of Providence, than which there can be nothing more sublime.

The conversion to the one state, and the restoration to that of the other, are gradual; and observe the necessary laws which effect the preservation of a most perfect equilibrium.

The spontaneous combustion of *ammonia* in *chlorine* is mentioned by Dr. Thompson, vol. iii. page 47. He gives the particulars of an experiment in which there appears a deficiency unaccounted for, which is cited here as one of the many

instances that occur where similar deficiencies are perceptible, and which are to be chiefly attributed to the hitherto unnoticed transition of matter from a fixed to a radiant state. He describes that on making a mixture of 8 cubic inches of ammonia, and 3 cubic inches of chlorine, 3.3675 wt. grains of salammoniac in a solid form will be obtained, and that 1 cubic inch of azotic gas will remain in a gaseous state; and that the gaseous product of such a decomposition amounts to 1-11th of the original bulk of the gaseous mixture. Now

The weight of 100 cubic inches of chlorine is 76.250 grains, therefore the weight of 3 cubic inches is 2.28750 grains.

The weight of 100 cubic inches of ammonia is 18.000, therefore 8 cubic inches weigh 1.44000

Total 3.72750

The weight of salammoniac obtained 3.36750

Weight of 1 cubic inch of azotic gas29951

Deficiency 06348

3.72750

which is equal to 1.522 in volume, and 0.57709 of a grain in weight on the 100 cubic inches, or $1\frac{1}{2}$ per cent. in volume, and a little more than half a grain in weight in 34.6995 grains, the weight of 100 cubic inches of such a mixture, or nearly $1\frac{1}{2}$ per cent. in weight on 100 grains.

Hitherto the attention of the eminent chemists, in their experiments on the gases, has been principally directed to their obtaining a *residuum*, or product *equal* to the amount of the gases on which their operations may have been performed, and they have considered that the nearer the product arrived at the quantity sufficient, to account for the *whole* consumption of the gases employed, the more they approached the desideratum of perfect accuracy in the result. Thus it has been laboured to prove, that an equal quantity of carbonic acid gas has been obtained with a given portion of oxygen, from the

diamond, and from *charcoal*, and *precisely the same results*. It is certain that the quantum of matter actually converted into the radiant state, in any one of such experiments is so minute, as to be in many instances beyond the reach of calculation, and that it is only by a repetition of experiments on the residual gases, that any idea can be formed of sufficient precision to afford satisfaction; this circumstance may have caused the fact of the transition of matter from a fixed to a radiant state, to have hitherto escaped their notice.

Whatever deficiency may have been perceptible to them, they have imputed in preference to some accidental loss, as an *evident ponderable result* was *always* the *object* of their *search*.

The experiments on gases are attended with some danger from explosion, unless effected with the necessary precautions, as to the quantity of the gases submitted to operation, which must, from a view to safety, be so small that the results relating to radiant matter can but with great difficulty, and the utmost precision, be attained.

It is not by the actual transition of matter from a fixed to a radiant state, that *explosion* is occasioned, it is rather the consequence of some residual gases unconverted, the poles of whose atoms are thrown into such positions, at the instant the transition ceases, that they repel each other with considerable force, added to the usual expansion proportionate to the increased temperature.

Gases can scarcely be said to be obtained in a state of purity unmingled with a portion of one or more of a different nature; and this circumstance occasions frequently the imputation of an appearance of a property foreign from the gas when in its *homogeneous state*.

We never find the MATTER of the *simple* gases in an *uncombined state*, we are therefore obliged to *separate* them from other constituents with which they are associated, by the

best means in our power ; and in doing so we scarcely reach anything like the precise degree of purity, which we so earnestly desire.

As the momentous ignition of any of the gases separately fired, when placed in a close vessel, depends on the presence of some one or more of the others, though but in a very minute proportion, perhaps after the usual applications for purifying gases by absorption, &c., the electric spark might afford the best means of producing a greater degree of purity.

One per cent. of azote has been found in oxygen gas procured from manganese by sulphuric acid.

The expansion of matter in the gaseous state on the application of heat, is the same according to Messrs. Dalton and Gay Lussac—100 parts of each species of gas at the freezing point of water is dilated to 137.5 at the boiling point.

Bodies when heated to a certain temperature become luminous from 752° to 800° of Fahrenheit. The capacity of affording light, evident to the sense of vision, is different : thus, *iron* wire becomes *red hot* when immersed in *melted lead*, which does not at the time afford the smallest appearance of light.

The simple gases are an exception : they do not become luminous at a much higher temperature, when SEPARATELY treated, because they have not there the necessary requisites to *produce light*, which can only be obtained by a *combination* of the matter of its rays in due proportion, and is resplendent in the ratio of their precise arrangement. As to their relative proportion, according to Sir H. Davy, bodies continue united, or resist decomposition, because they are in different electrical states ; that if we bring them into a similar state by making them both *positive* or both *negative* they will *repel* each other, and of course be decomposed ; and that this is effected by the galvanic battery which in his opinion will decompose any compound. He has applied this theory with success to the decomposition of the alkalies, showing them to be compounds of oxygen with a metallic basis. Some of the earths submitted

to the same influence; gave evidence of partial decomposition, while others resisted the greatest galvanic power he could apply to them.

With respect to galvanic influence and its evident effects in decomposing compound bodies, there appears to be strong indications of a well-grounded support to the theory of light, as laid down in these pages. First, the instrument is composed of *metals*, the *menstrua* of *water*, of *acids*, and *alkalies*; and according to the existing view of chemical analysis, it will be admitted that *oxygen*, *hydrogen*, and *azote* are present, and that we therefore have what is here asserted to constitute the requisites to produce *light*. The result of the action is this,—the *menstrua* and the *metals* are decomposed, and give a portion of their component parts at the opposite extremities of the galvanic apparatus.

Before we proceed further in adducing the proofs in support of this hypothesis, it is necessary to present a few of the opinions in brief of some eminent authorities.

Sir H. Davy observes, that the difficulty of refracting radiant heat, may be conceived to depend on the greater size of the aggregated particles, and that according to Newton, any matter moving with great velocity in right lines, may be conceived capable of communicating an expansive motion to the particles of bodies.

It is also remarked by Sir H. Davy, that if specific highly rare imponderable fluids be assumed to account for the phenomena, *as many* must be adopted as there are different series of effects produced by different rays. There must be a *matter* of a *violet* light, a *matter* of a *blue* light, a *deoxidating ethereal matter*, a calorific solar matter, and a calorific terrestrial matter, WHICH IS VERY CONTRADICTORY TO THE USUAL SIMPLICITY OF CAUSES.

But the experiments on solar phosphori render such a conclusion quite improbable. Pyrophorus, of Canton, if exposed to the *blue* rays—pale *yellow* light, and not *blue*, as it ought to

be, is exhibited, and it is still the same let any of the other rays be applied to it. Now this circumstance is a contradiction to the combination of *specific light* with other bodies, and the discharge of the same identical light in a state unchanged; in such case the light should be *blue* when exposed to blue rays. The explanation given to this phenomenon by Sir H. Davy is, that vibratory motion is communicated to the particles of the substance by the rays, in consequence of which, some of its own particles are slowly sent off, or that the particles have been formed into *new* aggregates, in consequence of the attraction of the substance.

The latter seems to accord better, but corresponding with the present views submitted in these pages, it would appear probable that an impetus is only required; nor is it material whether it is given by the entire, or perfect light, in a body of rays, or by any one ray distinct from the rest, the phosphorus containing in an occult state, the matter of *all* the essential rays, those deficient in the application are supplied by it, and the light is given out a *pale yellow* in *all* cases.

On the existence of a specific imponderable substance capable of producing light, and supposed to be contained in oxygen gas, and of a similar substance in inflammable bodies, it is the opinion of Sir H. Davy that *the facts are contradictory to the hypothesis*. He states that iron when heated to whiteness burns with amazing brilliancy in oxygen gas, throwing off sparks intensely luminous, but when heated to 600° Fahr. it combines slowly with the oxygen without producing light; that the chemical changes are of the same nature in both cases, and that the only difference is, in their rapidity and energy.

It appears, however, only necessary to raise the heat of iron to about 800° or 900° of Fahr., or a red heat, when it immediately assumes a *white* heat in oxygen gas, and the production of radiant matter proceeds with the most splendid combustion. Now, from analogy, we should conclude that iron contains hydrogen, carbon, and azote in its composition.

Carburetted-hydrogen, or bi-hydroguret of carbon, is that gaseous substance, which exhales in hot weather from stagnant pools and ditches of water, in the neighbourhood of towns.

Dr. Dalton first determined with accuracy its composition, and Sir H. Davy published experiments on it in 1811. It is colorless, has neither taste nor smell, specific gravity 0.555:—when a jet of this gas issuing from a tube is kindled in the *open air* it burns with a *yellow* flame, giving out a good deal of light; when mixed with oxygen gas, and that it receives an electric spark, it detonates with considerable violence. It does not burn unless the bulk of the oxygen rather exceeds its own bulk, and it actually ceases to burn when the oxygen is in *greater proportion* than $2\frac{1}{2}$ times its volume. If mixed with atmospheric air it burns, provided it amounts to 1-12th of the air, and it *ceases* to burn if it exceeds 1-6th of the air.—In all proportions between these two extremes, it burns with violence: for complete combustion it requires twice its volume of oxygen gas, and produces exactly its own volume of carbonic acid gas; the only remaining other product is water. This is according to Dr. Thompson, chap. iii. page 243, who concludes that carburetted-hydrogen is composed by weight of,

Carbon	0.416	0.750	3
Hydrogen	0.0694×2	$0.125 \times$	1

or one atom of carbon, and two atoms of hydrogen.

Sir H. Davy observes, the fire produced in a number of chemical processes, particularly in combustion, on the Newtonian view, may be ascribed to particles sent into free space, in consequence of the repulsion excited by other particles at the moment of their uniting into chemical union. Any solid bodies may be made to emit light, when exposed to a blast of air *very hot*, though not luminous, the light is always of the same kind; and this *circumstance* is favourable to the *idea* of the *possibility* of the *conversion* of *common matter* into *radiant matter*.

In radiant matter the particles act almost independently of

the common laws of attraction, and by prismatic refraction the difference of their actions is determined; and it seems probable, that the relations of the different particles to the crystalline arrangements of matter, will be found connected with those powers which they possess, *analogous to electrical qualities*.

If that sublime idea of the antient philosophers, which has been sanctioned by the approbation of *Newton*, should be true, namely, that there is only *one species of matter*, the different chemical, as well as mechanical forms of which, are owing to the different arrangement of its particles, then a method of analysing those forms, may probably be found in their relations to *radiant matter*. *Newton* supposed that the luminous particles at the violet end of the spectrum were *smallest* in size, and those at the red end *largest* in size; and those producing the intermediate colors of a size proportional. On this idea the calorific invisible particles would be the largest in the solar beam, and the calorific particles emitted by terrestrial bodies may be imagined of still greater size, so as to be incapable of passing through the *pores of dense transparent media*.

The rays at the red end of the spectrum tend to burn bodies, or to combine them with *oxygen*; those at the OPPOSITE END tend to restore *inflammability* to bodies; and negative electricity, which exercises the same functions, produces *hydrogen* gas from water; and this is the lightest chemical element in nature, and may be conceived to be composed on the corpuscular hypothesis of the *smallest particles*.

The latter investigations of light teach us that there is still much to learn, with respect to the affections and motions of radiant matter; and this subject, when fully investigated, promises to connect together chemical and mechanical science, and to offer new and more comprehensive views of the corpuscular arrangement of matter. See 'Elements of Chemical Philosophy,' 222.

The evidences submitted in support of this hypothesis are described under the following heads, and will be treated of separately :—

1st. That from the color of bodies, or that of their solution in menstrua of known constitution, or of their flame in combustion, some of their leading properties, as well as their original constituents, may be ascertained.

2nd. That light is not specifically combined with bodies, and that those which produce light, and are termed inflammable, do not burn in close vessels, excluded from atmospheric air, unless the constituents of that air, at the time, are present, as component parts of the body itself, or of what has been termed the supporter, or of both.

3rd. That bodies denominated supporters of combustion, if mixed above certain proportions with gases which are deemed inflammable, prevent their explosion and combustion.

4th. That the simple gases, having been previously purified by the electric spark, are not capable of ignition when treated *separately in close vessels*.

5th. That the only *simple substance* in existence which is termed *incombustible*, forms, in *combination* with other gases, bodies the most sensible of ignition, and productive of illumination the most *resplendent*.

6th. That at the common temperature, on the mixture of certain acids of great density with oils of the lesser specific gravity, spontaneous inflammation and *vivid light* are produced, which depend on the generation of caloric of high temperature by the revolution of the particles or atoms of the acids and oils, by which their poles are set at liberty to combine in the necessary order to form radiant matter; and that this never occurs unless the presence of the material elements of the three primary rays is evidently demonstrable.

7th. That oxygen, azote, and hydrogen, when brought into contact in given proportions, and fired by the electric spark, produce *perfect light*.

8th. That the influence of light, and its combination, in a refrangible state, with fixed, or inert matter, is particularly conspicuous in the growth of vegetable bodies; and that their health, vigour, inflammability, as well as essential and peculiar qualities, depend on its presence.

9th. That light also combines, in a similar manner, with the matter of the mineral kingdom; and that its influence is evident on the animal species.

10th. That if light is admitted to have entered into direct combination with fixed terrestrial matter, it is essential for the economy of nature that it should be again *restored* to the *radiant* state.

11th. *That from the color of bodies, or that of their solution, in menstrua of known constitution, or of their flame in combustion, their leading properties, as well as their original constituents, may be ascertained.*

It has been observed by Boyle, and repeated by Priestley, that diversity of colors does not denote any great difference in the internal structure of bodies, yet that it was often an indication of considerable alterations in the disposition of their parts, as appears from the extraction of tinctures, wherever the change of color regulates the artist in the process of their preparation: similar instances occur in the maturation of fruits. In like manner, in the method of tempering steel for engravers, drills, springs, &c. First, the steel is hardened by heating it in glowing coals; it is not quenched as soon as taken from the fire, but held over a basin of water, till it falls in temperature from a white to a cherry-red heat, when it is immediately plunged in cold water. The steel thus hardened looks whitish, and if it is brightened at the end and held in the flame of a candle, so that the bright end projects half an inch distant from the flame, it will swiftly pass from *one color to another*, as from a bright *yellow* to a deeper and reddish-yellow; from thence, first to a fainter, and then a deeper *blue*, either of which succeeding colors argues such a change made in the *texture* of

the steel, that if it be taken from the flame and immediately quenched in *tallow*, whilst it is *yellow*, it will be of such a *hardness*, as renders it appropriate for drills; but if kept for a few minutes longer in the flame till it turns *blue*, it becomes much softer, and is suitable to springs for watches, which are therefore commonly of that color. Lastly, if kept in the flame until the *deep blue* has appeared, it will become *too soft* even for pen knives. These colors are vivid, and though *superficial*, are completely indicatory of a change, which can be proved by comparing steel of these colors.—See Priestley.

In this case it would appear that in the course of combustion, a positive combination is formed between the steel and some of the *rays* of *light*; thus, first the yellow ray, then the yellow is mingled with red, by a species of oxidation, which gives the further facility to absorption of hydrogen, forming *carbon* (composed of the three rays), which assumes the predominancy when the *blue* ray becomes evident. The like transition of colors was observed by Boyle, on melted lead, in the act of cooling, by each succeeding pellicle assuming a rapid display of colors, but not regular in their succession as the steel. Thus, first, blue yellow and purple, blue green and purple, blue yellow and blue; red, blue, green, yellow, red, purple, and whatever color was displayed in the act of setting or cooling below fluidity, the metal retained superficially.

Now in the oxidation of lead, it would appear that until brought to a certain state of combination with the oxygen, the other rays of light are partially combined with the lead, and give evidence of their presence, but are ultimately driven off by its affinity for the oxygenating ray.

Kircher and Boyle observe on the *lignum nephriticum* of Mexico, that the infusion is limpid in *strong light*, in light shade is a beautiful *green*, more shaded, inclined to *red*, in a very shady place, and in an opaque vessel, green again.—Physiologia 57. In transmitted light, a golden color; in reflected light, appears a lovely blue color; shadow projected on it, tinged with

a golden color and a blue; by addition of vinegar the *blue vanished*; oil of tartar as deliquium restored the blue.—Boyle's Works, by Shaw, page 60.

Glass is affected by time :permanent prismatic colors are exhibited on its surface. This may be observed by examining the windows of old buildings, where it frequently appears that scales or lamina have been actually removed from some parts, rendering the surface uneven.

It has also been remarked that *nitric acid* which is colorless, when exposed for some time to *light* becomes *yellow*, and a quantity of oxygen gas is found floating on its top. If it be then carried to a dark place, the oxygen is gradually absorbed, and the acid becomes again *colorless*. The color of nitrous acid is *yellow*, derived from the predominancy of proportion which the azote bears to the oxygen and hydrogen in the first *combination*; however, on excess of oxygen in the second *combination* as nitric acid, the preponderating influence as to color is lost to the *nitrogen*, which is then no longer in maximum,—but, on the application of *light*, the first combination is (*à priori*) induced by absorption of the *azotic ray*, the oxygen in excess is separated, and appears in the state of *gas*; but on removal to the dark it is again absorbed, and the second combination is induced, and when completed the colorless appearance is restored.

There is a proof also of the *yellow* color afforded to flame by the presence of *azote* in a proportion beyond what is requisite to constitute *white light*. When a burning taper is let down into *ammoniacal gas* it goes out three or four times successively, but at each time the flame is considerably enlarged by the addition of another flame of a *pale yellow* color, and at last this flame descends from the top of the vessel to the bottom.—Priestley, ii., 381.

The composition of ammonia is well known to be hydrogen and azote, the oxides of manganese, gold, or mercury, when treated with it are reduced, the ammonia disappears, and azotic

gas remains, as proved by Scheele. Oxide of copper, similarly treated by M. Bertholet, was reduced, one part of the hydrogen of ammonia combined with the oxygen of the oxide, and produced water, and the azote was disengaged in the state of *gas*,—the analysis of ammonia by Bertholet, 121 azote, and 29 hydrogen, Mem. Pav., 1785. By Dr. Austin, 121 azote, 32 hydrogen. Phil. Trans., 1788.

OF NITROUS ACID.

IF oxygen gas is mixed with nitrous gas a quantity of red fumes appear, which are *nitrous acid*.

Nitrous acid is of a brown or red color from the combination of azotic and oxyginating rays; when to this acid, concentrated, a fourth part by weight of water is added, the color is changed from red to a fine *green*, occasioned by the excess of the hydroginating ray in union with the azote and oxygen in their then existing proportions. Priestley has observed, that water impregnated with nitrous acid, in a state of vapour, first became *blue*, then *green*, and ultimately *yellow*: and this proves the azotic ray became predominant, and caused the change.

When a solution of the juice of red cabbage is made in warm water, it is of a dark *purplish-blue* color. It contains oxygen and hydrogen, which are in a measure neutralized, and carbon, which is evidently predominant in coloring principle. When you add to a wine glass of this liquid a few drops of a solution of either potash, or soda, or ammonia, the color is changed to a *green*, proving the combination of the *azote*, of the *alkali* with the carbon, and hydrogen of the vegetable solution.

When to this you add a few drops of any of the acids,

(all of which are known to contain *oxygen in excess*,) the *green* is changed to *red*; by adding more of the alkali, the green is restored, and by a fresh dose of acid, sufficient to neutralize the alkali, first the blue returns, and by a further, the red is again reinstated: thus proving the alternate change of color, and that it depends on the predominating ray, or mixture of rays then constituting the exposed surfaces of the atoms forming the liquid; evincing the correspondence that exists between the original elements, and the *properties, qualities, and colors* they produce in matter, from the proportions in which they combine to form it; and that in most instances the reflected rays accord with those rays *in excess*, in its constitution. There is an exception, as far as color, exhibited in the instance of *iodine*, in solution in water, but there the *yellow* tint becomes evident by the neutralization of the coloring powers of *oxygen* and *hydrogen*, in their proportions to constitute water.

There are many instances in which solid and liquid bodies do not exhibit in the color they assume the traces of their composition, they are therefore neutralized as to the coloring principle, and require the addition of agents, the component parts of which are familiar to us, to cause the development of their constituents.

The acids in a fluid state are, in many instances, transparent and colorless. The alkalies are in a concrete form, *white*, and in aqueous solution equally transparent, and free from color as the water in which they are dissolved; some metallic solutions are similar.

Vegetables display in their growth a diversity of color and shade; and it would appear that the circulation of their sap and juices is essential to the display of those vivid tints to which they owe their tenacity. When they are allowed to grow in places from which *light* is completely excluded, they are totally *white*, and void of those colors which they uniformly exhibit when possessed of the natural advantages arising from

the presence of light, on which their perfection in properties and color inevitably rests.

It would seem that they acquire all that is necessary to their growth and stability, under the influence of *light* in the *day*, and many plants are known (as discovered by Linnæus) to close their leaves at *night*, and open them again at morn, to taste the genial warmth and invigorating action of the rising sun.

Plants have been taken from the open air, and placed in a dark room, and having closed or folded their leaves, the apartment has been suddenly illuminated with lamps, on which they have again unfolded them; thus evincing the influence of artificial terrestrial radiating matter, and proving its analogy to that of the solar beams.

The general color of plants and trees in the state in which they vegetate is *green*, importing the presence of *azote*, *carbon*, and *hydrogen* in their composition; when their leaves fall, and that fermentation takes place, a dissipation of their juices ensues, they turn *yellow*, and often of a *reddish-brown*, from the discharge of a portion of their carbon in carbonic acid gas, the quantity sufficient to retain the *green* color no longer exists, and they are yellow from a predominancy of azote, or reddish-brown, in proportion to the acid qualities retained by them, from the presence of oxygen.

Plants, in their growth, absorb hydrogen and azote, and reject oxygen, but when they are no longer possessed of vegetative life, they combine with oxygen in their state of dissolution, which renders the air in forests, in that season, the less adapted to animal respiration.

In metallic oxides where oxygen is known to be in combination, the color they assume is not uniformly *red*, but approaches that tint in proportion to the quantity combined and corresponding with the nature and original color of the metal itself. Thus the first oxide of iron is *yellow*, the second approaching *deep orange*, or reddish-brown the third a *puce color*.

In like manner the 1st oxide of lead is *yellow*, the 2nd *red*. According to Doctor Thompson the 1st, or protoxide of iron, is *black*, and is combined in the following proportions:—

100 Iron.
28 Oxygen.

The 2nd, or peroxide, is *dark red*, and is a compound of

Iron 100.
Oxygen 42.295

The traces by analogy that iron is a compound may be considered probable from the following circumstances:—1st, that it is known to combine with *carbon*, in many proportions, $\frac{1}{120}$ part of carbon forms soft cast steel;

$\frac{1}{100}$	part carbon	common cast steel;
$\frac{1}{90}$	„	the same, but harder;
$\frac{1}{80}$	„	ditto, too hard for drawing;
$\frac{1}{50}$	„	white cast iron;
$\frac{1}{20}$	„	mottled cast iron;
$\frac{1}{15}$	„	black cast iron;
$\frac{9.5}{100}$	„	plumbago.

From Mr. Mushet's Table.

Doctor Thompson, in his analysis of iron, communicated by him at the Liverpool Meeting of the British Association, shows that iron contains

—— Manganese
—— Silica
as well as —— Carbon,

2ndly. That it combines with oxygen.

3rdly. That it will not combine with hydrogen, nor nitrogen, in their *simple* state; therefore, as constituents, they are in excess.

4thly. That iron affords brilliant light when ignited in oxygen gas; which it would not do, unless it possessed hydrogen and nitrogen.

From the hypothetical theory here presented, we may reason, speculatively, on the implied composition of several bodies, taking their actual color, or that of their combinations with

other matter, as importing a direct trace by which they may be defined. Thus, we may suppose *chlorine* to be a compound of nitrogen (yellow ray) in excess, carbon (as a compound constituent), and hydrogen.

One reason to ground such a conclusion is its *greenish* color, and that *carbon* will not combine with it.

Chlorine destroys the color of indigo, in the same manner as nitric acid; and the yellow ray imparted by the Voltaic circle, which is an instance of their analogy.

Sulphur affords in its character circumstances favourable to the opinion of its compound nature. 1st. From its color, which is a greenish-yellow, it indicates that nitrogen and hydrogen, with carbon, are constituents; as well from the color of its flame—a bright violet—in which oxygen, as a component part of carbon, must contribute the reddish tinge, forming, with blue (hydrogen), the *violet* color.

2nd. That it *crystallizes* at 220° of Fahrenheit.

3rd. Melted in an open vessel, and poured into a basin of water, it assumes a *red* colour, is as soft as wax; but when exposed to the atmosphere, it recovers its brittleness, but retains its *red* color.

4th. As *lac sulphuris*, in combination with a small quantity of water, it is *white*.

5th. That it combines with hydrogen, carbon, chlorine, oxygen, and phosphorus; therefore, the simple and compound constituents of which it is formed are numerous, and not in such *excess* of proportion as to exclude combination with a further minute quantity of any of them.

Sulphuretted hydrogen burns with a purplish flame.

The color of *arterial* blood is florid *red*; while that of *venous* is a dark reddish-purple. The oxygen absorbed in the act of respiration forms carbonic-acid gas, which is evolved; and the alternate changes from arterial to venous blood, and the reverse, while kept up during the life of the animal, are still indicated by the *color*, evincing the predominancy of oxygen in

the red, arterial, and its greater deficiency in the purple, venous blood.

The action of oxygen gas on venous blood, by producing an immediate change to a scarlet-red color, has been proved by Priestley, Hazzenfratz, and Davy. The effect of atmospheric air is similar.

Venous blood, exposed to the action of nitrogen, continues unaltered in color.

When *nitrous* gas is applied, venous blood becomes a deep purple, which may arise from a further neutralization of oxygen; for with nitrous oxide it is a bright purple; with carbonic-acid gas a brownish-red colour, as observed by Dr. Beddoes.

Azotic gas, and carbonic-acid gas, gradually afford to *arterial* blood the dark color of venous; even the removal of *pressure* produced the change in color, by placing arterial blood *in vacuo* (Priestley); consequently, the appearance of color may be in such instance occasioned by a change in the *surfaces* exposed by the atoms, on altering the position of their poles, from new acquisitions of additional constituents, or from the abstraction of one, or more: in either case, the position of the poles may be varied, and a fresh surface exhibited, rendering a difference of colour evident.

Chlorine, when poured on venous blood, produced a deep, almost *black*, colour (Hazzenfratz); while muriatic acid effected no change (Fourcroy).— See Dr. Thompson.

The predominant constituents affording COLOUR, occupy the *upper hemisphere* of the compound spherical atoms of liquids. The application of the microscope to fluid bodies while undergoing change of colour, from addition of constituents, may afford much information.

ELEMENTS OF THE ANCIENTS.

THE bodies assumed by the ancient philosophy to constitute the original principles, or elements of matter, have been long since demonstrated, in the most satisfactory manner, to be compounds.

The scientific of the present enlightened age have established, by a general consent, an admission that the undecomposed substances, from which all other matter is formed, are now (by an increase of 14 since 1818) in number *fifty-four*.

This conclusion has been supported by the difficulties these bodies have presented to the several attempts at their analysis, with the insufficient means we have hitherto possessed in reference to their decomposition. It cannot, however, be advanced in favour of such a system, that it is in desirable accordance with that sublime simplicity—the acknowledged attribute of an Omnipotent creative power.

It is recorded in the 1st chapter of Genesis, 3rd verse, that when this earth was newly formed out of nothing, the Divine Author of the universe called forth *light*, as if by the agency of its power, to modify the chaotic embryo of this terrestrial globe, and bestow on it the transcendent beauties of Nature.

Impressed with this view of the implied agency of *light*, and reflecting on the known combinations of oxygen, hydrogen, and nitrogen, existing so generally in the animal, vegetable, and mineral kingdoms; the diversity in quality, and appearance of substances composed of the SAME *original* principles, from the simple variation of a diminutive proportion in even but ONE of their constituents, and that many of the bodies termed at that period (1818), and which are still similarly considered as undecomposed give, from *analogy*, strong traces of a compound nature, I was induced to venture on the inquiry at a period so distant (1818), with the hope to effect a removal of the difficulties, by enlisting in the investigation

some *lover of science*, to devote his time and talents to the consideration, how far our present systems of physics and chemistry were, or were not, arduously complex, and capable of improvement by a reduction to a state of consistent simplicity, *as regards the original elements?*

The following catalogue enumerates that extensive corps, whose ranks every lover of science must delight in seeing reduced, by the abstraction of one name which has been allowed to hold a position so eminent, unless unquestionably supported in its title on the basis of *truth*.

The reference now made, I beg to repeat, is to the following *fifty-four bodies*, at the present time acknowledged in our *systems of chemistry*, to be the original elements, or undecomposed constituents, of which all other substances in nature are supposed to be formed.

Oxygen.	Lithium.	Zinc.	Uranium.
Hydrogen.	Calcium.	Antimony.	Tungstenium.
Nitrogen.	Barium.	Tin.	Molybdenum.
Chlorine.	Strontium.	Bismuth.	Mercury.
Sulphur.	Magnesium.	Manganese.	Silver.
Selenium.	Alumium.	Chromium.	Gold.
Boron.	Silicium.	Cobalt.	Platinum.
Phosphorus.	Glucinium.	Arsenic.	Palladium.
Carbon.	Ittrium.	Nickel.	Rodium.
Iodine.	Zirconium.	Vanadium.	Osmium.
Bromine.	Thorium.	Cadmium.	Cerium
Fluorine.	Iron.	Columbium.	and
Potassium.	Lead.	Tellurium.	Iridium.
Sodium.	Copper.	Titanium.	

There are but *three* among this number which form *original homogeneous gases*, and as *that condition* is the surest and best test of *originality*, there ought to be homogeneous gases of every denomination of matter, distinguished as undecomposed. Thus we should have an *auric* gas, an *argentine* gas, &c. &c., which is not the case. On the contrary, the only three gases to be denominated perfectly homogeneous,

oxygen, hydrogen, and nitrogen, are not to be found (*per se*) in the solidified state, but are always discovered in combination with other fixed matter; which therefore would strongly indicate that there is not any *solid whatever*, which can be reduced to the perfectly homogeneous elastic, or gaseous state; and thereby an evidence is adduced, that *all solids must be compounds*, and if such is the case, the propriety of admitting any solid to assume the rank of an original element, does not appear to be justified; and all the other gases, save *three*, are evidently of a compound nature, including *chlorine*, which by its color (green), its odour, and its chemical qualities, affords every indication of being, like the others, a compound.

One of the evidences in favor of the establishment of the compound nature of *carbon*, is the fact that it cannot be reduced to the state of a *homogeneous gas*, while it readily forms heterogeneous elastic fluids, in conjunction with oxygen, &c. Now, if it were truly an *original element*, it would exhibit itself as such, and we should have a *carbonic gas*,—the attainment of which has not been effected with all our efforts hitherto applied; the colour of carbon being black, and its originating from the combustion of *vegetable* substances of known composition, exhibit strong proofs in favor of its compound nature, while the vegetable origin so recently imputed to the diamond, by Sir David Brewster, from its glutinous and laminar formation*, affords every reasonable expectation that *carbon* will not long retain the appellation of an original element.

The difference which appears to exist in the constitution of *terrestrial*, from that of *celestial light*, is, that the former is produced from the combustion of oxygen, hydrogen, and *carbon*; the two latter forming carburetted hydrogen, while the

* If it shall be finally established that the diamond is of vegetable growth, and that in its incipient state it is that viscous or gelatinous production occasionally discovered in gardens and the open fields, it may be ultimately traced to the beautiful *dew drop*, that brilliant, pure, and splendidly pelucid prototype of the diamond, we may fairly add of the *first water*.

first, with carbon, forms (occasionally) carbonic oxide, both of which are inflammable; but *pure light* is produced by the ignition and conversion of the *three original gases*, from the fixed to the radiant state, by their combination in the following relative proportions in weight and measure, and constitute perfect white or *celestial* light.

Oxygen by wt. 16.	Vol. 5.	Nitrogen 14.	Vol. 3.	Hydrogen 1.	Vol. 8.
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The order of polarity exercised in the formation of light is constant and invariable, being by the positive pole of the *oxygen*, with the negative poles of the nitrogen and hydrogen, uniting at the centre of the spherical compound molecule, or corpuscular atom of light. The *chemical* qualities of the solar ray and of terrestrial light are in some respects evidently dissimilar—while the former exerts a power which dissipates GOLD, and reduces its constituents to the elastic or gaseous state. Terrestrial light can exercise no power whatever, beyond the simple reduction of the noble metal to the liquid state*.

This must be imputable to the introduction of carbon in the formation of terrestrial light, which may cause a difference of polarity in the molecules which cannot probably correspond with the polar arrangements peculiar to *gold*, and may *repel* instead of *attract*, the particles, and such light is consequently paralysed as to its power to volatilize bodies of *such constitution*.

When the matter of *light*, however, reverts from the state of *radiancy* to that of *fixation*, such transition is effected by a polarity diversified according to the *constitution* of the *fixed body* by which it is (electively, as to its refracted rays,) absorbed

* The application of the oxy-hydrogen blow-pipe, with the additional aid of *lime* (the alkalescent earth), where the presence of nitrogen is evident, may be found to afford (from the intense white light it produces) the solvent and volatilizing powers of the solar rays.

and combined. The latitude is exercised of effecting not only a chemical union by the *poles inappropriate* to the formation of *radiant light*, but also with those which are *the sole and peculiar poles* by the combination of which light can alone be constituted; and this affords a great and immense amplitude of combination which occasions that variety so evident in the constitution and properties of fixed bodies generally, in the animal, vegetable, and mineral kingdoms; and to such an extent of diversification is it carried, that *no exact duplicate can be found of anything in nature*.

To the youthful tyro who may be one to indulge me by the perusal of these pages, I must observe, that nothing can be with propriety admitted as an *established law in a system of science* until supported by a train of incontrovertible facts, in testimony of its rectitude, and therefore the strongest scrutiny is advisable on the advance of *novel views*, lest the projector may have been led away by sanguine opinions of his premises, and which might terminate in fallacious conclusions.

It is not to establish theoretic views, but to *induce investigation* that they are now advocated, as such inquiry (if serious and persevering) may lead to valuable results.

ABSORPTION AND DISCHARGE OF LIGHT WITHOUT COMBUSTION.

LIGHT appears to enter into some bodies of a particular description, from which it may be disengaged without the aid of heat, or evident combustion, as shown by the early experiments of Father Beccaria on bodies which, when exposed to light become *luminous*, and when removed to a dark room, give out their light for some time, and this property is renewed in those bodies by fresh exposure to the influence of light.

Such is Canton's pyrophorus, or dry phosphorus, composed of oyster-shell lime and sulphur, exposed to a red heat for an hour.

The conclusion drawn from this circumstance was, "That light is not only acted on by other bodies, but it is capable of uniting with them, and afterwards leaving them without any change."

If we consider, from analogy, that in oyster-shell lime, which is an alkaline earth, nitrogen and carbon are constituents, and in *sulphur*, hydrogen, carbon, and nitrogen, are present, they, in the operation of forming the compound, may absorb oxygen at a red heat. The principles of light, according to the present theory, are combined in the pyrophorus; but imperfect in their proportions, and also in their polarity of combination, yet possessing the power to attract and absorb the whole of the rays of light, as it is admitted light is subject to the laws of *attraction*, and consequently possesses *gravity*.

But if the established measure of the velocity of light is granted, we must presuppose a propelling power, which may be *repulsion*, as before alluded to; and that force must operate as *pressure*, and in a direct line from the radiating point; and under the influence of that force, the absorption of light by an opaque body so composed, and of an irregular unpolished surface (less capable of reflection), on removal to a dark room, the direct influence of the *pressure of radiant light* being withdrawn, instead of retaining what it had absorbed, it is now disposed to discharge it, and possessing in its integral parts the principles which constitute light, although these principles, from want of exactitude in proportion, and other necessary advantages of polarity, are not in their then position capable of immediately becoming *radiant* matter without an *impetus*, yet possess the power to develope what they had acquired by attraction, during the application of pressure, and perhaps to render it perfect by supplying any deficiency.

The discharge of light from the pyrophorus may be rendered more evident by the aid of caloric, as in the instance of the experiments on the glass globes, but consequently the one

immersed in hot water continued for a *shorter* duration in a luminous state, the quantum absorbed being equal in both.

Now, if the pyrophorus had not possessed *all* the elements of light, and nearly in appropriate quantities, the light would not have appeared perfect. Mr. Wilson has proved that the *blue* rays act with greater effect than the others, on many pyrophori, and that they cause an extrication of *red* light. M. De Grosser has shown, that the same occurs with the *diamond*, which is a natural pyrophorus.—*Journal de Phys.* XX., 170.

With respect to the chemical combination between light and other bodies, as in the phenomena of the phosphori, it has been attributed to light that it enters into the composition of oxygen gas; in proof of which, it has been advanced by Priestley and Ingenhouse, "That when vegetables grow in the *light* they give out oxygen gas; but no oxygen is extricated in the *dark*, even though *heat* be applied."

It is evident, hence, that it is not from the atmospheric air, or water, that the *oxygen* is discharged, as both were present in the *dark*, as well as when the plant was exposed to light, but that the color of the plant, which depends also on the presence of light, is green, and that the nitrogen and the hydrogen of light, or the greater part of them, are absorbed, and chemically combined with the plant, and the *excess* of *oxygen* extricated and discharged.

It has been remarked by *Scheele*, that when the oxides of gold, or silver, are exposed to light, they are reduced to their metallic state, and oxygen gas evolved, as mentioned by Bertholet. This may be accounted for by admitting it possible that the other rays of light are absorbed by the metal, all but the oxygenating (red) ray, the excess of oxygen is discharged, the metal is reduced, acquiring *hydrogen* in predominancy, as an essential to such a state.

It can be shown, that substances termed inflammable do not

burn in close vessels from which bodies denominated (in our chemical system) *supporters* are totally excluded: the latter, are the atmospheric air, oxygen, chlorine, iodine, and fluorine; but *one* of which, by our theory, is considered simple, or elementary—namely, oxygen.

Now, a common candle, the oils, resins, wax, alcohol, &c. which are known to be compounds of oxygen, hydrogen, and carbon, do not burn in close vessels, unless some one of the supporters are present.

It will also be found that some bodies require one supporter, and some another (according to their constituents); and the only general one, is the atmosphere.

Hydrogen gas will not burn unless in contact with atmospheric air, or its principles.

If inflammable bodies, in the state of ignition, are introduced into *hydrogen gas*, they are immediately extinguished.

Pure carbon is not altered, or consumed, by the strongest heat that can be applied to it, the atmosphere and its constituents being excluded.

Charcoal, although it is a compound, and known to contain *hydrogen*, as ascertained by Davy, and *oxygen*, as imputed by Fourcroy; and quere, from its color, a portion of azote, as I presume to assert—yet will not burn, if the atmosphere, or oxygen, are not present.

Bodies composed of carbon and hydrogen, with or without other matter in combination, are the most subject to combustion in the atmosphere. Thus, we have in *coal* a familiar example of a body termed inflammable, composed of carbon and hydrogen, as two acknowledged constituents, combined with other matter, when ignited in the atmosphere, which is known to be constituted of oxygen and nitrogen, burns, produces light and heat; while the absence of the *oxygen* would totally prevent the formation of light, and would completely extinguish combustion.

In the experiments made by Sir H. Davy on inflammable

gases, he found reason to conclude, that when explosions occur from sparks of the steel-mill for lighting mines, the mixture of fire-damp, or carburetted hydrogen, with the atmospheric air, is in the proportion required to consume all the *oxygen* of the air; and that it is only in about this proportion, that explosive mixtures can be fired by electrical sparks from a common machine.

When a taper is burning in a mixture of carburetted hydrogen and atmospheric air, in the proportion of 1 to 12, the flame of the wick is seen within that of the fire-damp; when the mixture is in the ratio of 1 to 7 of the air, the flame of the wick is no longer visible; in the latter case, the color of the flame is, at the lower part, *green*; middle, *purple*; upper part, *blue*; showing, that in the lower part the nitrogen and hydrogen appeared green; in the middle the carbon, purple; and at the top hydrogen, blue, prevailed; but, evidently, *oxygen* was insufficient in proportion to produce perfect *white* light.

Now we also find that if oxygen, which is an admitted evident supporter of combustion, is added in *greater* proportion than $2\frac{1}{4}$ times the volume, to 1 of carburetted hydrogen, the **LATTER CEASES TO BURN.** We also find that carburetted hydrogen burns when mixed with atmospheric air, as 1 to 7 (when it is most explosive), at 1 to 15 of air, and even at 1 to 30; and that a mixture of 1 of nitrogen gas to 6 of explosive fire-damp, or 1 of carbonic-acid gas to 7 of fire-damp, *can totally paralyse their explosive powers.* This must be occasioned by the particular law of combination, dependent on polarity and electrical affinity; as carbonic-acid gas is a compound of carbon, a *combustible*, and oxygen, a *supporter*, as they are termed. It would appear that the order of combination, displayed in the formation of carbonic-acid gas, by the union of oxygen and carbon, is such, that the second atom of oxygen interposes as a protection against inflammation, by exhibiting contrary poles on the surface of the compound spherical atom, to those essential for the production of radiant matter, or light;

therefore, they cannot combine with hydrogen for such purpose till separated*.

There is a circumstance respecting carbonic-acid gas, mentioned by Sir H. Davy, worthy of notice:—that an electrical machine, totally surrounded by this gas, is capable of greater excitement than when insulated in *hydrogen* gas.

There is every reason to conclude that such should be the case when obtaining *positive* electricity.

Now carbonic-acid gas is (as well known) composed of 2 atoms of oxygen, and 1 atom of carbon.

We shall submit for selection two hypothetical arrangements of composition.

1st. The positive poles of the *two* molecules of oxygen are united to the negative pole of the *one* molecule of carbon.

In this case the positive poles of oxygen are protected from the polar attraction of hydrogen and nitrogen, in the order essential to the formation of *light*.

2nd. Let the positive pole of carbon be in contact with the negative pole of one atom of oxygen, while it is at the same time united by its negative pole to the other atom of oxygen.

Can the carbon, with strict obedience to the law of electrical attraction, occupy a *central* position, which would oblige the

* The exactitude of polarity appears necessary, as its deficiency, or interruption, occasions the complete prevention of chemical union essential to the transition of fixed matter to the radiant state, and causes combustion to be immediately extinguished; which is proved in the instance of *water*, as well as carbonic-acid gas, and several other bodies similarly constituted, of inflammables and supporters of combustion; for instance,

Oxygen and Carbon.	}	In Carbonic-acid gas.
Hydrogen and Nitrogen.	}	In Ammonia.
Oxygen and Hydrogen.	}	In Water.

And oxygen in excess in gaseous mixtures of carburetted hydrogen.

oxygen to submit to opposite electrical influences *at the same moment*?

It is possible that one atom of oxygen being united by its *negative* pole to the *positive* pole of an atom of carbon—forming carbonic oxide, which compound atom may unite with the positive pole of another molecule of oxygen, exhibiting therefore, inappropriate polarity, in the latter instance to permit transition.

There is a circumstance favorable to such an order of combination; when carbonic acid gas is placed in contact with charcoal, and heat is applied, it loses one portion of its oxygen, and becomes carbonic oxide,—which is capable of combustion in atmospheric air, and burns with a *purplish-blue flame*. Now, if we suppose the preferable pole of combination of the carbon is the *positive*, the atom of oxygen would have its negative pole combined, and its positive at liberty to unite with hydrogen and nitrogen, in the regular order for the production of light; and this is fully borne out by the facts exhibited with regard to polarity under the agency of the Voltaic battery.

This appears however certain, that bodies so constituted, that their poles appropriate to the formation of light are not on the *surfaces*, but at the *centre* of their compound atoms, must, to enable them to undergo transition to the radiant state, be first resolved into their original elements by separation of their molecules,—and that in bodies termed inflammable, there are facilities afforded as to the needful changes in polarity, which are not to be found in other fixed matter termed *incombustible*. The form of matter in the elastic or gaseous state, we may conclude is spherical. The atoms or particles, when homogeneous, preserve their globular shape, having positive and negative poles at opposite points on their spherical surface.

When combined in the ratio of, for instance, of one atom of oxygen with one atom of hydrogen, the positive pole of one unites with the negative pole of the other, and from the attraction of

cohesion, or their opposite electricities, the surfaces in contact are extended to the utmost limit from the primary point of junction, which then becomes the RADIUS of the newly formed sphere, of which the two original molecules are but the hemispheres.

When formed of two atoms of one body, or element, and one atom of another, the positive pole of the single atom attracts the negative poles of the two others, and a sphere is again formed of which the *three* molecules occupy compartments proportional to their respective magnitude, and governed by their respective densities which determine the position of the positive pole of the compound atom, and those of the molecules which become lateral and superficial.

In case they are equal in area, the negative pole of the single atom rests at its usual points, but the positive pole of the new compound sphere is to be found on the surface immediately opposite, and these two exercise power as the *active poles* of the compound atom; the two positive poles of the two atoms of one of the elements becoming then *inert* (as far as *direct* combination occurs), but may act *laterally* in bodies where *great cohesive power is exercised*.

An opposite order of combination naturally occurs, where the single atom may be united to the two other atoms by the *opposite* poles to those already described in binary and ternary, and also in quaternary compounds.

Whether matter is formed of one, two, or three atoms of one element, with *one* of another, or of two others, or in conjunction with other compound constituents, the same order of union is observed at the centre of the compound atoms; that is, by the opposite poles of the molecules held in combination, *one governing the rest by its powers of attraction*, to which the others are separately and collectively subservient for the time.

The more intense the state of *fixity* (occasioned by shielding

the poles appropriate to radiant combination), the more difficult the re-resolution of matter, whether in the solid or fluid state,—the general agent is heat or caloric, another term for a condition of *light* (as here presumed), by which the fixed bodies are first expanded, their original constituents liberated from the bonds of attraction, and they are prepared for new changes. Even those solid bodies termed inflammable, require conversion to the gaseous state to constitute their perfect combustion and re-resolution to the radiant state; and *combustion is but the exercise of natural Voltaic electricity* operating a continuous change of matter from one state to another.

Inflammable bodies are usually ternary compounds, containing two original, and one compound constituent—oxygen and hydrogen with carbon—but they are not unfrequently quaternary, having portions of *nitrogen*, and there are instances in which that element forms the chief component part in union with one or more of the others.

Azote or nitrogen has been hitherto denominated the *only simple incombustible* substance in existence; it may require some explanation for giving it a place among bodies acknowledged to possess opposite qualities.

Nitrogen constitutes nearly *four-fifths* of our atmosphere; and when we contemplate the duties it performs in obedience to the *Divine Power*, we must acknowledge and admire its aptitude for the purposes it is destined to fulfil.

It appears to be the selected barrier opposed to the sudden transition of matter from one state to the other, operating as a moderator in *combustion* as well as *respiration*.

It effectually corrects the energies of combination, which, if unrestrained by its immense and merciful agency, would endanger the safety of this habitable globe, and render man subject to immediate destruction from the first accidental convulsion arising from a change in the existing state of matter, at once instantaneous, unbounded, and overwhelming.

But it is not on its being an absolute *incombustible*, that its powers depend, for we find, when combined with certain proportions of other matter, it is *inflammable*, and *explosive in the highest degree*. Chloride of (azote) nitrogen, iodide of nitrogen, protoxide, and binoxide of nitrogen, are instances of this description. It is to the excessive proportion of aggregation in which it exists in atmospheric air, we are to attribute its *negative* or *neutralizing* powers. And we find that *oxygen*, a well-known supporter of combustion, *if in excess*, for instance, in greater proportion than $2\frac{1}{2}$ volumes to 1 of carburetted hydrogen gas (as before stated), totally prevents its combustion; we find also that a taper plunged into a jar of hydrogen gas, *although open to the atmosphere*, is at once extinguished, that the hydrogen only burns at the *surface* in actual contact with atmospheric air. Let it be held in recollection that *nitrogen* is *four to one* of oxygen in our atmosphere, and that *oxygen*, the most brilliant and effectual supporter of combustion, at but $2\frac{1}{2}$ volumes to 1, acts, in the instance of carburetted hydrogen, as a *decided extinguisher of combustion*. Not from their nature or qualities of oxygen and nitrogen are such phenomena derivable, but from their opposition when in a state of *aggregation* to permit the junction of appropriate poles of fixed matter, to effect transition to the state of radiancy or *light*. It is evident also that any of the simple gases will not inflame, nor burn of themselves in close vessels, but that a mixture of them with each other, or in contact with common atmospheric air (composed of nitrogen, four to one of oxygen), will submit to immediate combustion, often brilliant, and producing much *heat* and *light*—for the former is but the latter in an imperfect state.

The equality of expansion of matter in a gaseous state, has been before observed, and the *rays* of *light* are similarly affected by caloric, uninfluenced by their respective densities, or specific gravities.

If further instances are necessary to show the effect of *proportion* in the promotion or suppression of combustion, in reference to inflammable bodies and their supporters, it may be mentioned that when phosphoretted hydrogen comes in contact with atmospheric air, it takes fire and burns with great splendor; yet when mixed with *oxygen* gas in a small glass tube, it does not undergo spontaneous combustion.

When phosphoretted hydrogen gas is mixed with *chlorine* it burns with a greenish-yellow flame, but when one volume of the former is added to three of the latter, they combine and disappear altogether, and form muriatic acid and a brown matter.

Phosphorus burns in atmospheric air at the common temperature, 55° to 60° , but will not do so in oxygen gas under 80° Fahrenheit.

When phosphuretted *azotic* gas is mixed with oxygen gas, it becomes luminous, but when phosphuretted *oxygen* gas and phosphuretted *azotic* gas are mixed together, no light whatever is produced, even at the temperature of 82° Fahrenheit, observed by Dr. Thompson.

When *oxygen* is combined with *sulphur* on the proportions of 2, or 3 to 1—the inflammability of sulphur *no longer exists*.

In like manner nitrous oxide is capable of supporting combustion, but when oxygen is united in greater proportion, that power is no longer retained.

At the common temperature, on mixture of the mineral acids of great density with oils of the lesser specific gravity, spontaneous combustion, and vivid light are produced, which depend on the generation of heat of high temperature occasioned by the revolution of the atoms, of which the acids and oils are composed, by the friction of which, the electricities are excited, and the action similar to the Voltaic is produced, by which the poles of the molecules are set at liberty, to combine and form radiant matter, and this never occurs unless the presence of the three elements, or primary rays (according to this hypothesis), is evi-

dently demonstrable. Thus, when a small quantity of concentrated nitric acid mixed with a few drops of sulphuric acid, is poured on an ounce of oil of turpentine, instant inflammation, and most resplendent combustion ensues.

Nitric acid is composed of 1 atom nitrogen—5 atoms oxygen.

Sulphuric acid ditto, 2 atoms sulphur—3 do. of oxygen; oil of turpentine contains of Carbon 14 equivalents—oxygen 1 eq.—hydrogen 10 eq.

Doctor Ure.

Atmospheric air—4 nitrogen—1 oxygen.

Thus we have all the constituents of light (according to the views here set forth) present at one time.

The influence of *light* on vegetation is so well established, that it is scarcely necessary to trespass on the reader with further observations.

The experiments conducted with so much accuracy by Sir H. Davy, Mr. Knight, and others, to ascertain the aliment of plants, their consumption and growth in a given period, sufficiently prove that they owe to *light* not only all their beauty, but much of their *substance*; for it was found that a plant originally weighing not more than $1\frac{1}{2}$ lb. placed in a tub containing garden mould, the weight of which was accurately noted, the plant was regularly watered with distilled water for upwards of two years, while it was exposed to the sun's rays in the day, and carefully inclosed with glass at night; at the end of the period the mould was taken out and weighed, when it was ascertained that out of 150 lb. in weight it had not lost more than 6 or 7 ounces (the dust accidentally blown away); while the plant had increased to about 67 pounds, having no other aliment than *light*, and *water*, and *atmospheric air*. It is easy to conceive that from the water hydrogen and oxygen were in part derived, and nitrogen from the air as well as oxygen; but the CARBON did not exist in the air or water to such extent, and could only be produced by the action of *light* in combining the three essential rays in conjunction with the constituents of water and air, to produce *carbon*; for it is fully acknowledged that vegetable bodies which *grow in the dark*, and where LIGHT is totally

excluded, have NO FIBRE, but are watery and unsubstantial, and never reach maturity, or their natural form or beauty.

In animalization, the three original constituents, oxygen, hydrogen, and nitrogen, are admitted as essential, to which *carbon* (original or compound) is also added by general consent.

In respect, however, to latent *heat* becoming evident, by the action of respiration, and the consequent change produced in the blood, without presuming to offer an opinion, I beg to refer to the views of Doctors Black and Crawford, and on the difference between the specific heat of arterial and venous blood, to the facts as ascertained by Doctor John Davy, and that of oxygen gas, and carbonic acid gas, as declared by MM. de la Roche and Berard, with the results of the experiments on the application of artificial respiration kept up in the lungs of a decapitated animal by Mr. Brodie, as recited in the Philosophical Transactions, 1812, imputing the production of animal heat to the action of the brain. I shall, without more than reference to opinions emanating from such high authorities, merely submit the following observation, confined to the probable *chemical action alone* :—

The accumulation of caloric, or heat, appears to arise from the mutual action of the *surfaces* of the particles or atoms, in changing the position of their poles, and by *consequent friction* eliciting those electric influences, on the exercise of which every *species* of *decomposition* and *re-combination* depends, and the energy of such caloric must correspond with the *attractive force* which is exercised.

The temperature of the lungs is apparently modified by the caloric discharged in the act of *expiration* of the air inhaled, as well as by the new portions of venous blood, which succeed the ejection of the arterial, to which is to be added the low temperature of the air inspired; and that in addition to general circulation the decompositions which take place in the other parts of the body, influence the approximation of an equaliza-

tion of temperature throughout. In treating of caloric, or heat, I wish to be understood as not considering it otherwise than as a modification of *latent light*, which disturbed by the separation of its molecular constituents, by the operation of natural electrical changes, produces the sensation called heat, terminating either energetically in visible radiancy of light, or *falling back* to a state of temporary quiescence, until the *equilibrium* shall be again *disturbed* by some operation of nature or art.

When we contemplate the variety of purpose to which the elementary constituents of WATER are applicable, we cannot be sceptical as to the sublime simplicity with which the beauties and excellencies of all we see on earth are produced from a few original elements,—when we observe that the oxygen and hydrogen gases, in their due proportions, form a limpid, translucent, colorless, and tasteless liquid. Again, the alcoholic fluids are highly spirituous and volatile, from a change of proportion and an addition of carbon, then highly acetous from an increase of *oxygen*; it must be evident to us that those diametrically opposite qualities are the consequences not only of variation of proportion as to the elementary constituents employed, but of a diversity in their polarity of combination.

VOLTAIC POLAR DETERMINATION.

IN the operations of the Voltaic circle, it is apparent that the determination of *oxygen* is to one pole or electrode, while that of *hydrogen* is constantly to the other, and that *nitrogen*, which appears to occupy the intermediate position, is occasionally diverted to one pole or the other, according to the nature of the substance, or body, submitted to decomposition. Thus in *chlorides*, the *chlorine* being a compound (as here presumed) of *nitrogen*, *hydrogen*, and *oxygen*, flies to the positive electrode, while the base (suppose soda, a compound in which *nitrogen* predominates) is diverted to the *negative* electrode.

It is observable that by the action of the common electrical machine, no effect of *heat* is exhibited, except on the discharge by which equilibrium is restored and light is produced. This would intimate that the *effect* of *heat* is absent, when the direct *decomposition* of *light* is occasioned by the separation of the *positive* from the *negative* portions of electricity; but that it becomes apparent only in their *re-union* during their passage through media, the constituents of which are disturbed from the *friction* occasioned by the energy and velocity with which the decomposed *electricity* (or *light*) passes to accomplish re-union.

In Voltaic electrical operations where the separation and re-union are *continuous*, it is quite different, the disturbances are unabated, and the excitation progressively increases, so that the *sensation of heat is rendered evident*, and by duration is productive of what is termed increased temperature.

Phosphorus, at present numbered as one of the original undecomposed bodies, appears, on the contrary, to be composed of radiant matter or light, in such a loose uncombined state with matter which may be deemed *fixed* or *palpable*, that it is, as it were, an amalgum of both.

It has the power to emit light without undergoing combustion.

It will spontaneously inflame on contact with hot water.

If rubbed on the hands, or any part of the body, in a dark room, it will appear highly luminous, without producing the *sensation of heat*.

Phosphorus is not luminous in either *nitrogen* or *oxygen* gas, but is completely so in atmospheric air—being a mixture of both, as *one* to *four*. It is a natural product chiefly derived from animal matter.

Organized *vegetable* bodies, which are acknowledged to be composed of the three original elements, oxygen, nitrogen, and hydrogen, with carbon (here asserted to be a compound of the three), become the aliment of organized *animal* bodies, which

are composed of the like constituents, only differing in their relative proportions, and affording other compounds and their consequent qualities, which it is not necessary here to describe. In the analysis of the BRAIN, however, evidence has been afforded of the fact, that *phosphorus* is a component part to the extent of certain proportions, which are in themselves relative, in a measure, to the *sanative* state and perfection of the *intellectual powers* of the being from whom the brain may have been taken; and it has been supposed that when the quantity of phosphorus fluctuates from 2 to $2\frac{1}{2}$ per cent. of the brain, the party was possessed of sound intellect; while, when it exceeded $2\frac{1}{2}$ and reached 3 per cent., there was a degree of eccentricity, and at 4 to $4\frac{1}{2}$ *complete insanity*; while, on the other hand, descending to $1\frac{1}{2}$ produced imbecility, and to 1 per cent. to the gradation suitable to animals of the lower order.

The phosphorescent power of the glow-worm and the fire-fly are well known, and that of the *pyrosoma Atlantica*, as described by M. Peron, observed by him in his voyage from Europe to the Isle of France, is extraordinary and worthy of notice. See Gurney's Lectures, pages 201, 209. By this it would appear that a voluntary power exists in the *pyrosoma Atlantica* to produce the phosphorescence to the surprising extent described, at pleasure, for its protection and service. These are instances of the *production* of LIGHT *without* being accompanied by any degree of *sensible heat*; and this may arise from the facility of union afforded to the constituents of *light* which are not *obstructed* or *impeded* in their progress to combination, and therefore are not necessitated to submit to that *excitation* and energy of action, which on most other occasions produce the *sensation of heat*.

Phosphorus may be obtained in fine *octohedral* crystals, by slow cooling in large quantity after fusion, as M. Trantween describes. Doctor Turner mentions in his elaborate work, "Elements of Chemistry," page 288, that the presence of certain gaseous substances, even in *minute quantities*, has the

remarkable effect of preventing the slow combustion of phosphorus, at 66° of Fahr. : it is entirely prevented, as observed by Mr. Graham, (Quarterly Journal of Science, N. S., vi. 83.) by presence of

		Volumes of air.
1	Volume of olifiant gas	in 450
1	,, vapour of sulphuric ether	,, 150
1	,, vapour of naphtha	,, 1820
1	,, vapour of oil of turpentine	,, 4444

It is rational to impute to the presence of *phosphorus* that beautiful exhibition of prismatic colors, which is visible in mother-of-pearl, &c., being phosphate of lime, &c.

TRANSITION OF FIXED INTO RADIANT MATTER.

IN the celebrated experiment on the oxygen and hydrogen gases, for the production of water, by three eminent French chemists, Fourcroy, Vauquelin, and Seguin, in 1790, in which 7249 grains in water, of the gases, were ignited with the greatest care and precision, there was at the termination an evident loss, or absence of the fixed matter under operation, to the extent of 5 grains= $1\frac{1}{7249}$ th part of the whole.

From this and other similar operations on the gases, and also from some of the many experiments of Doctor Thompson, in his analytical pursuits, where results of deficiency have occurred, I should venture to define the relative proportion of matter which passes directly to the radiant state of *light*, to be equal to the 1-1500th part of the whole of the fixed matter submitted to ignition, where the *two gases, oxygen and hydrogen, are alone* employed, or in conjunction with solids or fluids, which require reduction to their original elementary constituents. But from the *excessive quantity of light* produced by the ignition of the THREE GASES, *oxygen, nitrogen, and hydrogen* together, the computation of the amount of DIRECT TRANSITION to the *radiant state*, must very far exceed that proportion, and may be found to equal 1-500th part of the gases employed.

That such a small proportion of matter as appears to be convertible from the fixed to the radiant state, not only by the customary operations of nature, but those of mankind in the accomplishment of the arts, is an instance of the Divine care which presides over the *universe*, preserving that perfect and essential *equilibrium*, so necessary to the existing course of our system. And while an excess of *nitrogen* exists in our *atmosphere* exceeding the oxygen, by 4 to 1, or in a ratio of 80 to 20, instead of being as 3 to 5, or 15 to 25, the needful quantity of oxygen is to be found combined with matter in the form of *earths* and *water*, and providential protection is doubly insured by the *hydrogen* in like manner being held in combination, to perform the particular functions allotted to it.

Thus but small portions of the three gases essential to the formation of *light* are to be found at any time in an appropriate state of *freedom* and *proximity*, for sudden transition from the fixed to the radiant state, and consequently *perfection reigns around*.

ON THE METALS.

THE existence of *hydrogen* as a REDUNDANT constituent in ALL the metals is rendered more than probable by the *color* of the light they afford, on submission to the action of Backhoffner's electro-magnetic machine, and modification of Professor Daniel's battery, with Palmer's arrangement of binding screws, &c., thus—

Gold	exhibits	Whitish green-coloured light.
Silver	, ,	Bright green.
Platina	, ,	White.
Brass	, ,	Green.
Tin	, ,	Purple (bright).
Iron	, ,	Purplish-blue with reddish-brown scintillations.
Zink	, ,	Bright <i>blue</i> with <i>red distinct</i> .
Lead	, ,	Violet (bluish).
Bismuth	, ,	Bluish-purple.

In every one of the above, save platina, the *blue ray* or

hydrogen, is evident : by analogy we might venture to predicate the analysis of the metals, from the colors they display in this experiment ; thus (speculatively supposed) would stand the proportional constituents :—

Metal.	Color.	Oxygen.	Nitrogen.	Hydrogen.
Gold . .	Whitish green . .	2 . .	4 . .	3
Silver . .	Bright green . .	1 . .	2 . .	3
Platina . .	White	1 . .	1 . .	1
Brass, a compound metal	Green	1 . .	3 . .	3
Tin . . .	Purple	2 . .	1 . .	3
Iron . .	{ Purplish-blue, with reddish-brown scintillations . . }	2 . .	2 . .	5
Zinc . .	{ Bright blue and dis- tinct red . . . }	3 . .	1 . .	3
Lead . .	Violet	2 . .	1 . .	4
Bismuth . .	Bluish purple . .	1 . .	1 . .	3

We may consider it probable, that in the conformation of the metals the polarity may be such that those poles appropriate to the *organization of radiance* may be always in the *centre* of the compound atom, and so protected in their combination that their re-solution, first to the fluid and then to the gaseous state, is extremely difficult. Thus we may suppose a molecule of oxygen united by its radiant proper pole (the positive) to the *two* or *three* negative radiant proper poles of nitrogen. That next a molecule of nitrogen is united by its radiant proper pole, the *negative*, to the two or three radiant proper *positive* poles of oxygen ; that a similar arrangement occurs with *hydrogen* ; and that the metals, NOT NOBLE, may have arrangements in polarity, where, by the union between *nitrogen* and *hydrogen*, one of their radiant poles proper must of necessity (being both negative) be always exposed on the *surface* of the compound atom, by which easier reduction or fusibility, and lower specific gravity, may be occasioned. And that from gradual disparities in polar arrangement of other bodies increasing the exposure of the poles (I denominate for

brevity sake "*radiant proper*") on the surfaces of the compound molecules, every degree of inflammability may be attained, and that in PHOSPHORUS the entire of the *poles radiant proper* are completely exhibited on the surfaces of its atoms, and its transition is consequently voluntary and difficult to restrain.

While experimenting on Backhoffner's electro-magnetic machine at Mr. Palmer's, of Newgate-street, of whom I purchased it (and where many very interesting specimens of philosophical apparatus are to be found), he was so good to point out a curious phenomenon in electricity he had *accidentally observed*, and *could not account for*. On applying an instrument of flat plate-glass, with the word *Fire* written in extended parallel lines, with the usual dots of foil, and a discharging ball of brass attached, he observed, on holding the end of his thumb at about an inch distant from the foil on the WOODEN HANDLE, that a most brilliant and beautiful spark of an inch in length, of distinct homogeneous RED light, was obtained, and continued to be discharged, from a common electrical machine, with a cylinder of about 12 to 14 inches in length.

The machine was charged with POSITIVE electricity, and the colour of the light was of the *intensity* and brilliancy of the RED *prismatic ray* of the solar beam.

I repeated the experiment immediately in broad daylight, and had the satisfaction to obtain an additional proof in corroboration of my views to the one kindly afforded me, by Mr. Abraham of Sheffield, at the meeting of the British Association at Liverpool, in September last, to which I have before alluded, that *oxygen* and the *red ray* of solar light and POSITIVE electricity are IDENTICAL.

It is in substance mentioned in that excellent work, Dr. Lardner's Cabinet Cyclopaedia, in the volume containing that admirable discourse on Natural Philosophy, by J. F. W. Herschel, Esq., M. A., &c., late Fellow of St. John's, Cambridge.

That the verification of theories depends much on “*collective data*,” and that the inferences to be drawn from their comparative coincidence afford an *average* of proofs, far superior to that of a single (although more glaring) instance, and being consequently less liable to erroneous conclusions.

Of the THREE prescribed ways by which we may possibly arrive at the knowledge of the laws which regulate the action of our primary agents, our desired VERÆ CAUSÆ, I have pursued the SECOND for the reasons I shall beg to submit. The *first* is (briefly) by a continued series of inductive reasoning, “inferring from circumstances the amount and intensity in each particular case, and then by piecing together these ‘*disjunctæ membræ*,’ generalizing from them, and so arriving at the laws desired.” The second, “By forming at once a *bold hypothesis*, particularizing the law, and trying the truth of it by following out its consequences and comparing them with facts.” The third is, “By a process partaking of both these, and combining the advantages of both, without their defects, viz. by assuming indeed laws we would discover, but so *generally expressed* that we shall include an unlimited variety of particular laws following out the consequences of this assumption, by the application of such general principles as the case admits,—comparing them in succession with all the particular cases within our knowledge; and lastly, *on this comparison* so modifying and restricting the general enunciation of our laws, as to *make* the results agree.”—See (210) Discourse on the Study of Natural Philosophy, page 198.

There is a degree of presumption so strongly implied by the course selected and followed in these pages, that I deem it needful to offer a few observations in justification.

The value of inductive reasoning in the attainment of an unquestionably safe gradation of ascension to the most important laws, founded on a train of incontrovertible facts, must be universally admitted, and that such a system of inquiry,

although slow in progress, is at least guarded by circumspection, and must in the end lead to the top of the pyramid.

The only objection that can be advanced against an undeviating adherence to *this process* is, *the period required for its operation*, that if in our pursuits so far on our journey a PROSPECT has presented itself indicating, from the DATA ALREADY OBTAINED, that it is not longer needful to restrict ourselves further in the *outworks*, but that the way is now open (equal to the great Western Railway), and by the TRAIN of extraordinary and astounding discoveries of recent development, we may be at once conveyed equally safe by a course of projection by which we can attain the desired TERMINUS, with much greater celerity, why not let some of the DARING amongst us attempt the achievement?

To those friends of science who are so disposed, I beg with deference to submit this theory with the analogous, presumptive, collateral, and direct evidences with which it is accompanied—not for its ESTABLISHMENT, but (as I have before repeated) its RIGOROUS INVESTIGATION, with the assured hope that some little benefit may be derived from the discussion.

The experiments of Mr. Cross have been productive of *great benefit*: they have elicited inquiry and have called the attention of many scientific gentlemen to the THEORY *of the formation of metallic depositions*, by the agencies of electricity, in the constant exercise of the unceasing Voltaic apparatus* of nature, under the providential control of that Divine Power, the Author of all good.

Some ill-founded sceptical objections have, I believe, been very inconsiderately raised on the subject of the latter experiments of Mr. Cross, in reference to the accidental production of ANIMALCULÆ, from such materials as he has applied, in so much as they have ever been considered hitherto in *direct opposition* to the support, as well as to the *formation*, of bodies in

* To Mr. Children, F.R.S., is justly due the honor of having formed the first Voltaic battery of great magnitude in England.

animated nature. The existence of INDEPENDENT MATERIALITY is so universally condemned, that there is not to be found an atheist on earth to proclaim himself such; or a man so daring as to acknowledge the bare contemplation, much less the avowal, of such irrational opinions; and the TIMOROUS MIND may satisfy itself, that the production of animalculæ by Mr. Cross, from the action or agency of bodies of a reputed poisonous nature, is about as effectual in lessening our faith in DIVINE OMNIPOTENCE, as the production of MITES in cheese, exhibiting, as they do by their existence, the BOUNTIFUL ECONOMY observable throughout the universe.

On the contrary, it would only show us the implied simplicity of the *primary constituents, their paucity in number, and universal application* for the beneficial purposes of man, so that the same constituents which in one instance have performed their duty, as light, air, the grass of the field, the sustenance of the cow, milk, cheese, passing in its stages of fermentation (the putrefactive) to the formation of *minute animated* insects, to be again (at their termination of life) resolved into the appropriate forms, to resume alternately the prescribed round of UNCEASING CHANGE.—In the second instance we find that the SAME constituents having been exhibited in the shape of *corrosive acids and insipid earthy matter*, by mutual re-action, and by being submitted to Voltaic arrangements *mechanically applied*, have produced a species of animalculæ which from their organization are able to sustain life, in the deleterious mediæ in which they originated, and are an example of the protection afforded by *polar* arrangement, and rather a support to this hypothesis as showing the *opposite purposes* to which the primary elements of MATTER are, by variation of the order exercised in their polarity of combination, capable of being applied.

Bacon says, "There are two principal services, besides ornament and illustration, which philosophy and human learning perform to religion: the one consists in effectually *exciting* to

the exaltation of God's glory—the other affording a singular preservation against unbelief and error.”—*De Augmentis Scientiarum*. Bacon's Works, London, 1818, vol. vi. p. 63.

If mammoths have ceased to exist, and that they have only been the precursors of the elephant, and other useful mammalia which have succeeded them, who is it can question their utility for a time, and the benefit of the exchange?

The mask of prejudice is torn away, and we see and admire, from the cultivation of the sciences, all that can inspire us, by opening new sources of intellectual enjoyment, to confirm our faithful dependence on the blessings of a superintending Omnipotent power.

This is the effect of true philosophy: and its concordance with religion is so well described in the “Lectures on the Connexion between Science and Revealed Religion,” by the Rev. Dr. Wiseman, that I beg to give a short extract from that elaborate and valuable work:—

“And thus we come to form a noble and sublime idea of *religion*, to consider it as the great fixed point round which the moral world revolves, while itself remains unchanged; or, rather, as the emblem of *Him* who gave it the all-embracing medium in which every other thing moves, increases, and lessens, is born and destroyed, without communicating to it essential mutation, but, *at most, transiently altering its outward manifestation*.—We come to consider it as the last refuge of thought, the binding link between the visible and invisible, the revealed and the discoverable—the re-solution of all anomalies—the determination of all problems in outward nature and in the inward soul—the *fixing and steadying elements of every science*—the blank and object of every meditation. It appears to us even as the olive, the emblem of peace, is described by Sophocles,—a plant not set by human hands, but of spontaneous and necessary growth in the great order of creative Wisdom; fearful to its enemies; and so firmly grounded, as that none, in ancient or later times, hath been able to uproot it.”

It is satisfactory to all lovers of the sciences to know, that the absurd opinions of the fancied opposition of *philosophy* to *religion*, have ceased to exist in the most prejudiced minds ; and that discoveries in the nature of the PHYSICAL LAWS of the UNIVERSE, so far from creating irreverence, promote our ardent desires to pay our voluntary homage and adoration to the Divine Author of our being.

I shall add a few suggestions in reference to the subjects for experiment, which it had been my intention to have proposed to the learned and scientific gentlemen who composed the Committee of Mathematics and Physics, at the late Meeting of the British Association at Liverpool, had opportunity permitted ; but as the Section was so very much occupied to the last hour with matters of more importance, I pledged myself to Mr. Lubbock, the Vice-President, occupying the chair at the moment of finally closing the transactions, that I should take the earliest opportunity of placing before the Royal Institution (of which I have the honor to be a member) a complete epitome of my views ; and that I should publish them, for the purpose of *exciting investigation as soon as possible*, with the hope that something might be elicited BY EXPERIMENT, previous to the next annual meeting of the British Association.

First Subject of Experiment.

That observations should be made at distant stations, by the gentlemen habitually engaged in astronomical pursuits, to ascertain the *electrical state* of the atmosphere at a certain hour, say 9 o'clock of the morning, at noon, and at 10 o'clock at night, for a given period*, with a view

* I had in September last, when at Liverpool, proposed to Lieut. Morrison, R.N., to undertake, with his excellent electrometer, the necessary series of observations at Cheltenham ; at the same time I had the pleasure to communicate to him some of my views, as well as to other gentlemen, members of the British Association ; which views I had then hoped to have immediately submitted to that body, that more general tests as to its fallacy, or rectitude, of conception, might be applied, in reference to the Theory here set forth.

to ascertain if the average was positive in the day—negative at night.

Second.

That experiments should be instituted with electrical machines on *positive* electricity, noting its effects on oxygen gas and nitrogen gas as SEPARATE media, in which the machine may be enclosed, while the discharges of sparks may be given through any of the *three gases*, including *hydrogen*; the latter with due precaution against explosion. That the color of the electrical spark should be noticed, as afforded by the usual conductors, and by the substitution of others of various composition. That a machine should be prepared, capable of affording, with accuracy and convenience, NEGATIVE ELECTRICITY; and the same trials instituted as to *color* and effects with media and conductors of various constitution. Experiments on *negative* electricity, having been but TOO LONG NEGLECTED, if resumed, may lead to very important results, and the production of very interesting phenomena. I am now having one made, of which report shall be given in due course.

Third.

That *renewed* experiments should be instituted, to effect, if possible, the decomposition of the metals, or their reduction to the gaseous, or elastic state, which might be done on very minute quantities by the Voltaic electricity, in closed chambers, exhausted, or otherwise. That the same should be applied to CHARCOAL. That the first operations might be exercised on *iron* and *zinc*, as holding out prospects of easier decomposition. That also some interesting experiments on the decomposition of CHLORINE might be suggested to gentlemen familiar with analytical pursuits; and that the publication of such proposed experiments

might be afforded, through the medium of some scientific periodical work, for the promotion of science.

Fourth.

That a course of experiments should be instituted by such scientific gentlemen as may find leisure and disposition to individually undertake them, (the more numerous the better) on the refracted homogeneous rays of solar light, to ascertain their *effects* peculiar and distinct, on matter of known constitution on the metals, the acids, alkalies, on the separate homogeneous gases, and on chlorine, and the heterogeneous gases; and particularly in reference to the magnetic and counteracting influences by *the three homogeneous rays*.

Fifth.

That magnets of ascertained intensity of power be submitted to the influences of oxygen, positive electricity, and the red ray of solar light, as also the red ray of refracted *artificial* light, produced by the oxy-hydrogen blow-pipe, with the aid of *lime*, alkalescent matter, and with charcoal, with the view of deciding the *IDENTITY* of oxygen with positive electricity, and with the red ray of celestial and of terrestrial light.

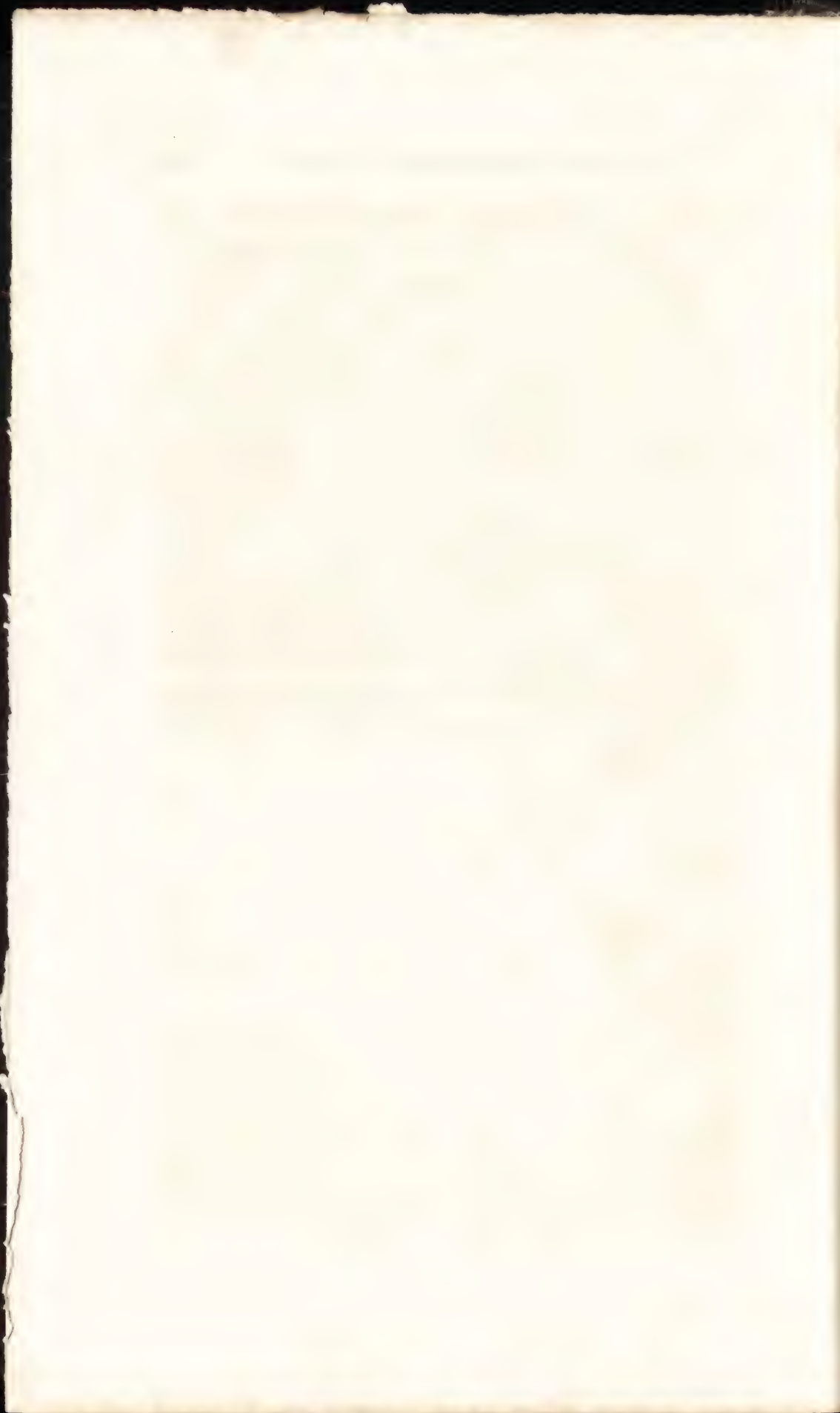
Sixth.

That further experiments should also be attempted in producing magnetic power by the blue ray and violet, end of the spectrum, with and without the aid of auxiliaries, such as alkalescent and hydrogenous matter, and with phosphorus and sulphur.

Seventh.

That particularly on the inflammation of the three gases in the proportion mentioned in the 9th article of this Theory, for the product of perfect white light, and with *modifica-*

tions of such proportions relatively, to approximate the most approved result. With a view to enable young operators to act with greater safety against **EXPLOSION** in the last proposed operation, I beg to state that I have procured and used for my purposes three brass stop-cocks, with adapted jets of small calibre, attached to bags of caoutchouc, of capacity sufficient to hold the three gases **SEPARATELY**, and by placing the points of the two containing the oxygen and nitrogen in direct contact, inserted in a small pipe or jet, so that they may *combine* when in the act of uniting with the stream of hydrogen issuing from the jet of the bag *kept separately* and containing it, by applying distinct and well regulated *pressure*, the proportions may be modified in discharge, to produce the best possible composition of light, and by such other experiments as may be deemed capable in their results, of confuting or establishing satisfactorily, all or any of the points described in these pages, as essential in reference to this Theory.



APPENDIX.

THE annexed Prospectus was first printed in Newcastle-on-Tyne, in 1818, and afterwards in 1820, in London. From the first, copies were sent to a number of gentlemen devoted to science, with a view to *excite* inquiry.

I had originally intended to have published a small treatise by subscription, but abandoned the idea, determining to wait the period when perhaps some further discoveries in physical science might create an interest on the subject, which at the time did not appear to prevail.

That epoch has at length arrived ; in every new work I now have the gratification to find some fact in support, or some new hint or opinion advanced, which shews the correspondence of the writer on one or more points, in which *we perfectly coincide in opinion*, and such parallel concurrences, often from particularly distinguished authorities, are most gratifying, as they afford me conviction, that I am not *a solitary, indulging in vague and visionary fallacies*, for there are hundreds who think and reason as I do, on a considerable portion of what I conceive it eligible to investigate, with a view if not fully, at least partially, to establish.

When this Prospectus was written, in the winter of 1817, the greatest correction of the errors of the Newtonian Spectrum, had been confined to Dr. Wollaston's reduction of the prismatic Colours from SEVEN to FOUR. I repeated his experiments, and was concluded by the same fallacious views, as in my observations, I found the *red and yellow rays well defined*, at one end of the Spectrum, the *blue and violet equally so*, at the

other, when afforded by the triangular prism, *white* light intervening.

I always felt strong suspicion of the want of *originality* in the VIOLET-coloured ray, and yet as I could not at the time get rid of it, without injustice, from the *defined* position it seemed to retain, and confirmed as it then stood, by opinions of such high authority, I was obliged to let CARBON stand *as the only solid element in existence*, while I freely consigned to the list of compounds, all the metals, from the analogous and collateral proofs I then possessed, of *their want of originality of constitution*.

My first calculations were made on TERRESTRIAL LIGHT, in which carburetted hydrogen, oxygen, and azote, were used, in the proportions stated in the analysis, in page 2 of the Prospectus. I have thought it better to give the original Prospectus with ALL ITS ERRORS, as it was printed and circulated, MY CORRECTED VIEWS AND OPINIONS being sufficiently declared in the Theory I have now presented.

Years had rolled on, and actively engaged in pursuits requiring the application of nearly the entire of my time, I continued to occasionally taste the enjoyments of Science, always rejoiced at her advance, but to devote no labour to the furtherance of my hypothesis, until by accident, about two years since, happily meeting with Mr. Field, I was, for the first time, struck with his prismatic lens, and its effects in establishing the reduction of the original prismatic rays, to THREE, with which the learned President of the Section of Physics and Mathematics, of the British Association, Sir David Brewster's discoveries, perfectly accorded. I was consequently enabled to do, consistently with my opinions, what I had long desired, to DISMISS CARBON from a position of constituency in CELESTIAL *light*; and convinced that as it was not THERE TO BE FOUND, and that the perfect imitation of Celestial Light was to be effected experimentally, by the ignition of the three original gases, Oxygen, Nitrogen,

and Hydrogen; and that as Carbon was not necessary, though commonly present in terrestrial light, it must be a compound of the THREE, and which I expect will be shortly fully demonstrated, from better authority, by its analysis. We have at present the indirect testimony, that it has not been reduced to the elastic or gaseous form, *per se*, and until such shall be the case, its title to be considered an ELEMENT is FAIRLY CHALLENGED, as are those of the metals, and all other bodies of fixed matter, the THREE before-mentioned original gases excepted.

PROSPECTUS

Of a New Work, entitled "THE ELEMENTS OF RADIANT AND FIXED MATTER," Octavo Size, with Plates, containing THE DIRECT EVIDENCES in support of the following THEORY OF MATTER, in which are described its presumed original Basis, with the Laws by which its reciprocal Transition to and from the State of Radiance and Fixation appears to be governed.

ORIGINAL THEORY. 1818.

Matter exists in four forms,—the solid, fluid, æriform and radiant.—The three first may be denominated inert or passive, and to the agency of the last, aided by caloric, are to be attributed the several changes evinced throughout the universe.

Light is a material compound, composed of the four* simple elementary principles, or undecomposed constituents of matter, of which all other bodies in nature are formed.

By a prism, light is divisible into four original prismatic coloured rays, which, by obliquity of position in the act of extended refraction, exhibit three others, which not being innate compounds, may be termed laminar intermediates, partaking of partial colorific intensity, as they severally approximate that point in the spectrum, where the original rays of which they are composed, are as to vision, evidently homogeneous.—*See fig. 1, plate 1st.*

* Three in the amended Theory.

The first four* primary coloured rays possess peculiarly distinct and countervailing qualities, and on the proportions in which they are combined in matter, and the nature of the polarity exercised in their combination, its specific properties are totally dependent.

The ray, or the first portion of the spectrum, possesses (as has been already proved by an authority of great eminence) oxydating and acidifying powers, and is here termed the oxygenating ray.

The second, or yellow ray, displays qualities which pertain to the nitrogenous and alkalescent, and is therefore denominated the azotic ray.

The third, or blue ray, is distinguished by its analogy to carbon†, and is here considered the carbonic ray.

And the fourth, or violet ray, is admitted to possess the dispositions of hydrogen, which entitle it to the appellation of the hydrogenating ray.

1. Light combines with inert or fixed matter, not specifically or bodily, but partially by absorption of its individual or separate rays, electively combined, from certain existing laws of attraction; and from the colour of fixed bodies, or that of their solution in menstrea of known constitution, or of their flame in combustion, the predominating original or simple elementary rays in their composition may be defined.

Caloric influences the combination of refracted light, with fixed or palpable matter, when at a temperature not exceeding from 800° to 900° of Fahrenheit, but affects the restoration of matter to the radiant state of light, when elevated to 1000° and upwards.

2. The repulsive power evinced by the particles or corpuscular atoms of light towards each other (when their active poles or those they exercise in the aggregate are paralyzed), is influenced by the peculiar nature of their individual polarity, being tertiary compounds, of a spherical form, combined by one positive and two negative poles at their centre, and therefore exhibiting on their external surfaces three positive poles at such angles as to act with repulsion on liberation from the influence of pressure, or that propelling power which emanates from the radiating point on which the visibility of light depends.—*See fig. 2, plate 1st.*

The greater illuminating power of that portion of the spectrum embracing the lighter green and deeper yellow, may depend on the higher specific gravity of those rays, as by multiplying their given relative

* Three by new Theory.

† Carbon excluded in the corrected Theory.

quantities, by the specific gravity of the fixed bodies they represent, they afford from analogy the following data, as their comparative intensity of illumination.—*See fig. 3, plate 1.*

Red Ray. 9·364	Yellow. 12·789	Blue. 6·593	Violet. 1·000	Light Orange or Deep Yellow. 11·647
Light Green 10·719		The Mean of the entire Portion. 11·076		

3. The Galvanic Phenomena among others support the conclusion, that the transition of matter to the radiant state of light, is effected by the combination of one atom of oxygen, by its positive pole, in contact with the negative poles, of one atom each of azote, carbon, and hydrogen; and that the reversion to a fixed state, is produced by a combination of the same atoms in a refracted state principally by their opposite poles, with bodies of fixed matter.

4. The existence of an equilibrium as to such gradual transition and reversion of matter, is not less consistent with its indestructability, than that already admitted in the daily formation of water, and the restoration of that body to its original constituents in the gaseous state.

Light is imperfect in colour and intensity, unless the presence of its four original constituents is evident, and nearly in the following ratio :

In Volume.		In Weight.	
Red Ray	16·250	Oxygen	5·5068 or 33
Yellow	25·417	Azote	7·5366 = 43
Blue	30·556	Carbon	3·6031 = 21
Violet	27·777	Hydrogen	0·5880 = 3
Parts	100·000		17·2345 100

Except one,* all solids, with which we are familiar (the metals included), all fluids, and the whole of the gases (3 only excepted), are compound bodies.

The colour assumed by bodies in a liquid state, on addition of new constituents, is dependent on a change of position of the visible surfaces of their compound atoms, arising either from an extension of their spheres by the new acquisition or a diminution in magnitude from abstraction of some portion of their original constituents, by which in either case a direct change as to polarity is effected. This may be elucidated by demonstrating the *nature* of the action of an acid, or an alkali, on the blue colour of vegetable juices.—*See fig. 1, plate 2nd.*

* Meaning carbon.

5. The health and vigour of vegetative bodies, as well as the colours by which they are adorned, is principally attributable to the transition of radiant matter to a fixed state.

6. As the crystalline forms assumed by bodies are governed by the number and position of the original constituents in their composition, and as no homogeneous body can consistently exhibit such diversity in its anatomical arrangement, the assumption of such forms by the metals is one of the many presumptive evidences in support of their compound nature.—See *fig. 2, plate 2nd.*

7. As all bodies, whether of the animal, vegetable, or mineral kingdom (as here presumed), are compounds, formed of nearly the same constituents, their peculiar properties and qualities are not to be considered as *innate*, but are to be attributed, in addition to variation in proportion, to a modification in arrangement, inducing a *polar* influence, by which their passage to other stages of fixity is facilitated or impeded, and they are rendered applicable to appropriate changes.—See *figs. 3, 4, and 5, plate 2nd.*

8. Thus matter is deleterious alone from an arrangement contrary to that consistent with animal organization, and not from qualities or properties peculiar to its constituents.

9. The order of polarity observed in the transition of matter from a fixed to a radiant state, is absolute and invariable, while that of its reversion from the latter to the former, by combination with bodies of fixed matter, is subject to a diversity governed by the nature of those bodies, which are endowed with certain proportionate degrees of fixation, or resistance to re-solution, as their poles alone appropriate to connection in the radiant state, are more or less protected from the influence of caloric in producing a separation of their elements.

As the simple gases, when treated separately and isolated, are individually incapable of combustion; and the only one of them denominated inflammable, extinguishes ignited bodies when plunged into it, and in combination with another gas termed a direct supporter of combustion, forms water, a body the most opposite in its nature to those which possess inflammability, while azote, the only substance described in chemistry as a simple incombustible with a slight acquisition of other matter, produces the most splendid ignition,—the humble individual, who with the greatest deference is about to submit the *direct* and presumptive Evidences he has collected from experiments in support of this Hypothesis, entertains the most sanguine hope to induce

a liberal investigation, and thereby to elicit from the more able and efficient efforts of the eminent Philosophers who are the ornament of the present enlightened age, the *truth* of which he is in search, either by the complete confutation, the appropriate modification, or the ultimate establishment, of the premises here set forth.

This little work contains, as a necessary appendage, a condensed review of the opinions of the most celebrated for Science, in the earlier and present times, who have expressed their sentiments on the subject: and refers, with due acknowledgments, to the accurate experiments of many Authors of the highest authority (particularly of the present day), for corroborating *facts*, as it is hoped, deducible in support of this hypothesis.

By J. H. KYAN.

There are a variety of other phenomena connected with Light, Electricity, and Heat, which, from the hurry of getting this to press, with a view to lay it before the President, Vice-Presidents, and Members of the Royal Institution, I am inclined to postpone till another opportunity.

One particularly, in reference to aerolites, and the nature of the metallic matter in their composition, *nickel*, and the magnetic power possessed by it; also, that these stones are absolute concretions from the residuum of gases, ignited by electric currents in our atmosphere, being occasioned by surplus portions of one or more of the original gases acting as a nucleus, and which have no opportunity to unite in the prescribed order of polarity, for the formation of radiant matter.

Upon what principle is it natural to suppose, that the three original Elementary Gases, Oxygen, Nitrogen, and Hydrogen, are never found as homogeneous bodies in a SOLID state?

The answer is (by implication), they would be so discovered, but that there is not any SOLID body in existence, established as homogeneous.

Again, why does Zinc, *a supposed element*, give, with the application of Backhoffner's Electro-Magnetic apparatus, two distinctly-coloured points in the star of Light, one *blue*, the other *red*?

If it were homogeneous, it *could not* exhibit such phenomena, which evidently imply the nature of its constituents to be compound; and so we are by analogy disposed to conclude.

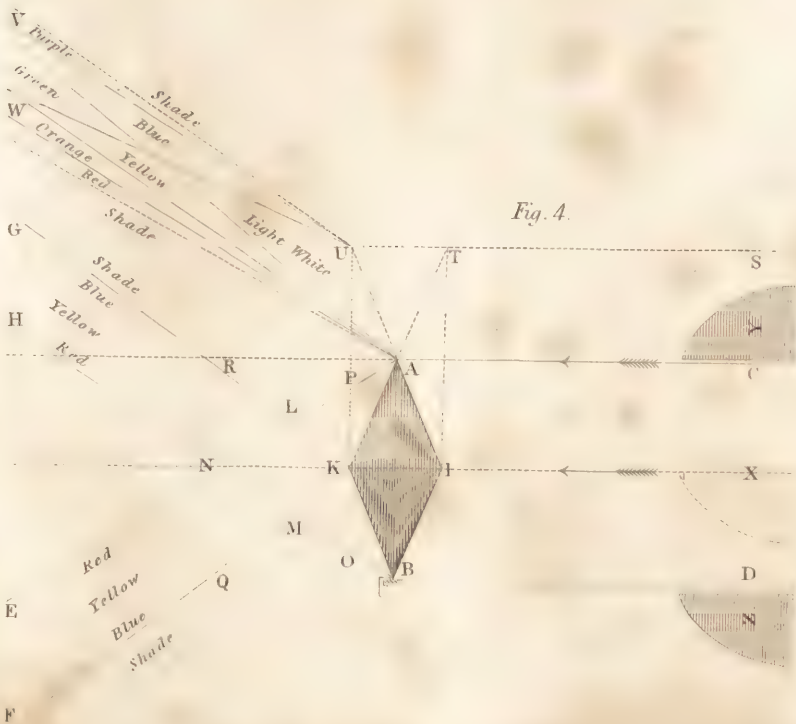
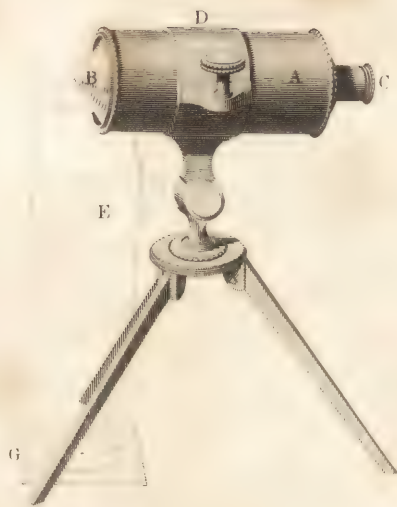
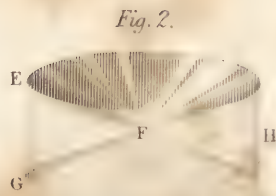
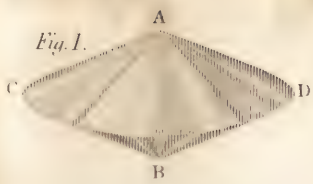


Fig. 5.

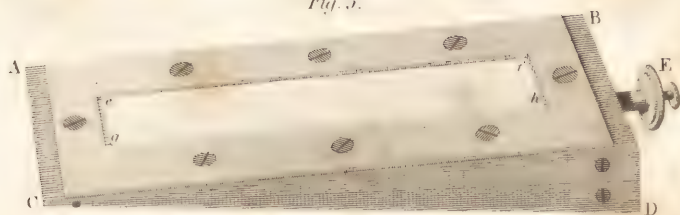


Fig. 6.

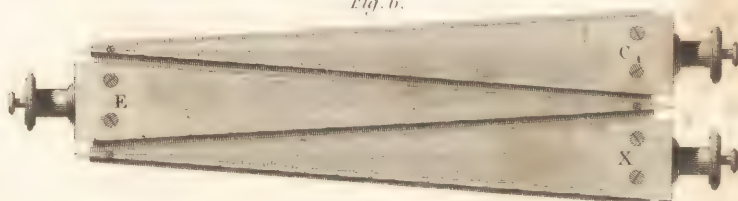


Fig. 7.

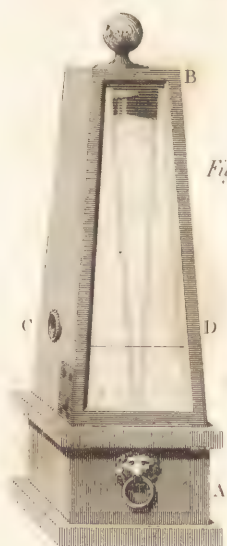


Fig. 8.

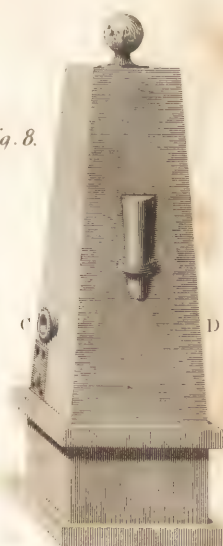
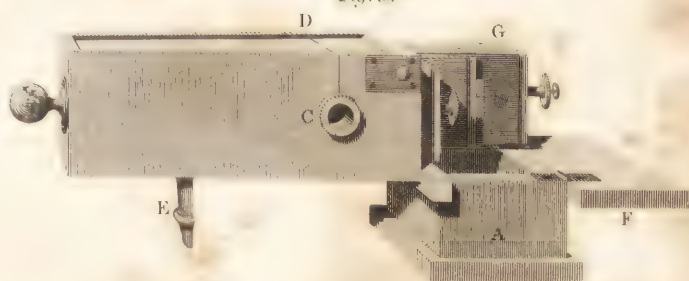
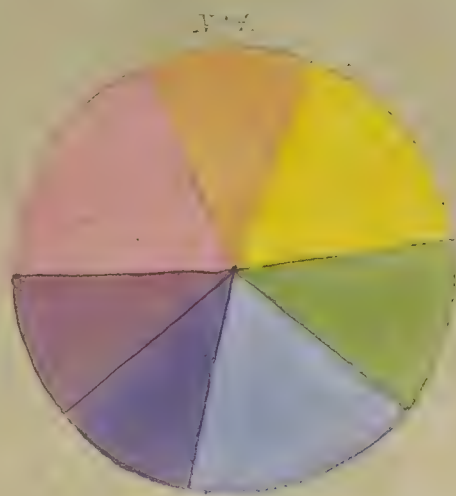


Fig. 9.











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